HDX-MS Analytical Instrument for Incorporation on a Robotic Rail, Featuring Dual Enzyme Chambers and HPLC Separations at -30 °C

Designed by

Dr. Jeffrey W. Hudgens

Construction instructions are within three documents:

1. The HPLC box and cooling system (this document) ….. 217 pages
2. The Multi-channel Temperature Controller ……. 31 pages
3. The Multi-channel Valve Controller ……. 26 pages

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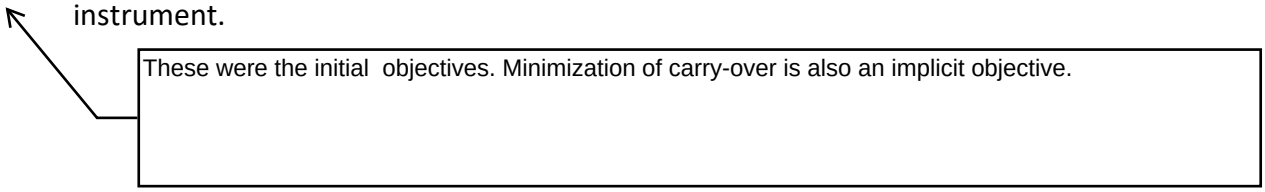
Design Objectives & Integration Plan

- Maintain height & depth of current cold box & provide mounting brackets to robot rail.
- Minimize back-exchange by use optimum temp zone scheme.
- Operate electrochemical cell at low T.
- Provide a permanent “store-in-place” facility for idle enzyme columns (providing constant H_2O flow and low T).
- Allow data collection with one or two enzyme columns.
- Improve HPLC resolution (but don’t sacrifice speed).
- Provide electrospray solvent rebalancing and supercharging capability by adding solvent mixes to analyte before entering ESI source.
- Test for robust hardware & software operation before installing into the current HDX-MS instrument.



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Comments on the Design and Construction

- The NIST housings were printed on TAZ 5 and TAZ 6 3D-printers in PLA plastic. All were serviceable but other plastics may work better. Large objects in PLA will not conform to dimensions exactly, thus, I have adjusted some parts so that they fit. PLA has some elasticity which will allow you to force the housing to fit the other parts.
- Most STL files fit on the TAZ platen. For the mask used on the door I have included a larger STL file that will allow production on a larger format printer.
- For some parts I have included both STL and IGS files. For the prototype these were fabricated in the machine shop; however, these may be more cheaply produced via 3D printing in steel or aluminum.
- Keep the coolant hoses as short as is practical. Hoses account for much of the loss of cooling capacity.
- Use foam sealing, where possible, particularly, on the surfaces of the PLA housing.
- When cooling the system, purge the box with dry gas, such as the boiled-off liquid N_2.
- The protease assembly allows precise control of the protease temperature. However, each vendor offers a protease column manifesting a unique profile (diameter and length). To standardize the profile presented to the protease clamp assembly, a two-piece silver or aluminum collet envelopes the protease column. The collet presents as a 0.65” OD cylinder. Thus, each protease column will require its own collet. Three collet designs are offered in the STL files.
- During operation the idle column has a flow of cleaning solution passing through it.

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TABLE 1: Cross-reference Table between Drawings and STL File Name

No.	Drawing Name	STL File Name
1	-30C Cover	(-30C)_Cover.STL
2	Accessory box (part 1)	Accessory box (part 1).STL
3	Accessory box (part 2)	Accessory box (part 2).STL
4	Accessory box (part 3)	Accessory box (part 3).STL
5	Accessory box (part 4)	Accessory box (part 4).STL
6	Accessory Mixer Sole Plate	Accessory Mixer Sole Plate.STL
7	Adapter to Accessary Box	Adapter to Accessary box adapter.STL
8	Aux Heater adapter	Aux Heater adapter.STL
9	Backside housing (left-4)	Backside housing (left-4).STL
10	Backside housing (right)	Backside housing (right).STL
11	Backside housing 2	Backside housing metal (left-2).STL
12	Backside housing Left (Alt-design)	Backside housing Left-3a-version_3).STL
13	Backside housing metal2 (left-1)	Backside housing metal2 (left-1).STL
14	Backside metal	Backside housing (left-3a).STL
15	Cold Chamber exit tube	Cold Chamber exit tube.STL
16	cooling tube clamp	cooling tube clamp.STL
17	cover right metal	cover right metal.STL
18	cover(-30C) base	cover(-30C).STL
19	cryo-endcap part 1	cryo-endcap part 1.STL
20	cryo-endcap part 2	cryo-endcap part 2.STL
21	d-sub 9-pin Connector Mount	d-SUB MOUNT(0C).STL
22	Exit port washer	Exit port washer.STL
23	EyGly mixer clamp	mixer clamp.STL
24	EyGly Mixer holder	Mixer holder.STL
25	fan tunnel top(-30)	fan tunnel top(-30).STL
26	HPLC Column clamp (part 1)	HPLC Colum clamp (part 1).STL
27	HPLC MOUNT clamp	HPLC MOUNT clamp.STL
28	internal (-30C) cap	internal (-30C) cap.STL
29	mask_front3(LEFT)	mask_front3(LEFT).STL
30	mask_front3(RIGHT)	mask_front3(RIGHT).STL
31	Power supply standoff	Power supply standoff.STL
32	Shell-back metal	Shell-back metal.STL
33	Side Cover	Side Cover.STL
34	union holder optimize (bottom)	union holder optimize (base).STL
35	union holder optimize (TOP)	union holder optimize (TOP).STL

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36	Valve adjust sleeve	Valve adjust sleeve.STL
37	valve wrench	wrench.STL
38	ACC Mixer Clamp	ACC Mixer Clamp.stl
39	Analytical Chamber Mask	mask2(0C).STL
40	Backside housing top metal	Backside housing top metal (left--back).STL
41	coolant exit plate	Cryobulkhead.STL
42	Cryo-Bulkhead	Cryo-Bulkhead metal.STL
43	Door Mask Cover	mask3_cap.STL
44	Dust Protector for Injection Port	Funnel.STL
45	Electrical Cover	Elect Cover.STL
46	Left Mask (0C)	mask4a(0C).STL
47	Lock-ring of Dust Protector for Injection Port	Funnel_lock_ring.STL
48	mask_front3	mask_front3.STL
49	**protease bearing well**	Protease bearing well.STL **(preferred)**
50	Reducing cell holder	Antec bottom holder.STL
51	RTD Platform	RX402_mount.STL
52	Snout (Removable)	Accessory box (part 1b).STL
53	Valve Actuator	thotler valve driver.STL
54	Valve Plate #2 Fan tunnel (bottom)	fan tunnel (bottom).STL
55	Valve Plate #3 Fan tunnel (bottom)	fan tunnel bottom(-30).STL
56	Waste Hose Clamp	Acc Hose Clamp.STL

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TABLE 2: Cross-reference Table between Drawings and IGS File Name

No.	Drawing Name	IGS File Name
1	Accessary Box Adapter	Accessary box adapter.IGS
2	Bracket (Plate #2)	Bracket (Plate #2).IGS
3	Capillary Clamp Riser	capillary clamp riser(-30C).IGS
4	Central rail (bottom)	Central rail (bottom)_2.IGS
5	Central rail (top)	Central rail (top)_2.IGS
6	cooling tube clamp	cooling tube clamp.IGS
7	cryoside strut	Cryo-side.IGS
8	cyrotop strut	cryotop.IGS
9	Enzyme Reactor Standoff II	enzyme stand-off.IGS
10	Enzyme Sole Plate	Enzyme Plate.IGS
11	Extension Top Plate	motor box extention top.IGS
12	Fan Mount (Plate #2)	fan mount (0C).IGS
13	Fan riser (part 1)	fan riser(-30C)-fan mount.IGS
14	Fan riser (part 2)	fan riser(-30C)-part2_fan mount.IGS
15	Fan riser (part 3)	fan riser(-30C).IGS
16	Guard Trap Mount	Mount Trap Column.IGS
17	HPLC Colum clamp (part 1)	HPLC Colum clamp (part 1).IGS
18	HPLC Colum clamp (part 2)	HPLC Colum clamp (part 2).IGS
19	left lock plate(-30C)	left lock plate(-30C).IGS
20	Mixer Clamp	Mount Trap Column top.IGS
21	Motor Assembly to Rail Adapter	motor assembly to rail adapter.IGS
22	motor box extension	motor box extention.IGS
23	motor box side panel (interior)	motor box side panel (interior).IGS
24	Motor box side panel (outside)	motor box side panel.IGS
25	Motor Rail Base	motor rail base.IGS
26	Protease Base Plate	Enzyme Base Plate.IGS
27	Protease Bearing Well	protease bearing well.IGS **(Use STL)**
28	Protease Column BottomClamp	Column bottom1 Clamp3.IGS
29	Right Lock Plate	right lock plate.IGS
30	right lock plate(-30C)	right lock plate(-30C).IGS
31	Standoff valve plate #3	Plate #3 standoff.IGS
32	Top Clamp Assembly for Protease Column	Column top1 Clamp3.IGS
33	Valve #3 Plate	Plate(-30C).IGS
34	Valve Plate #2	three in lne.IGS

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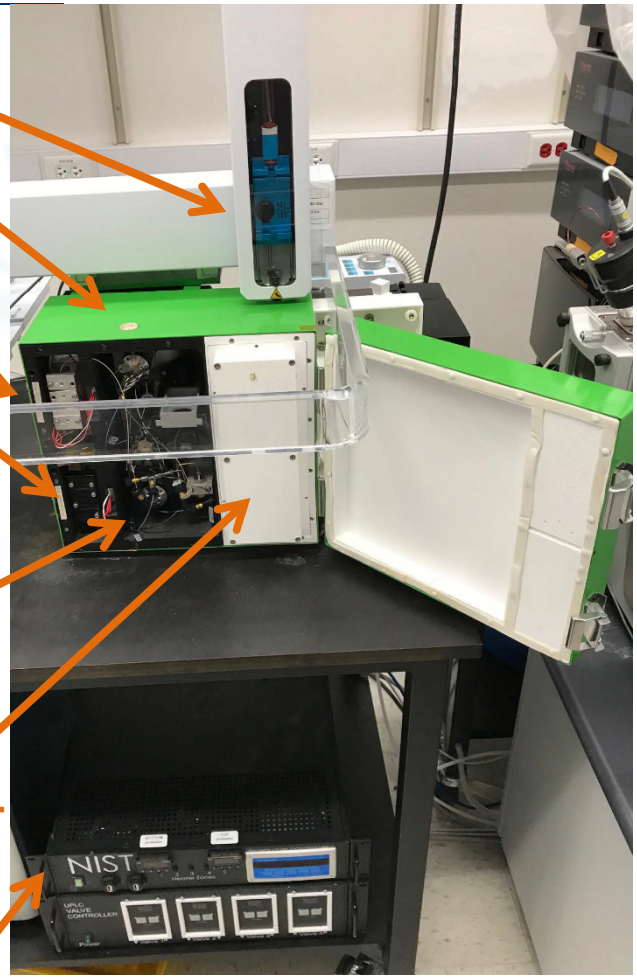
NIST -30 °C HPLC for HDX-MS

-- Optimal system for mAb analyses

- Operation at -30 °C reduces H/D back-exchange rates by x40 as compared to 0 °C operation.
- Greater peptide LC peak capacity is obtained when using 40 min LC gradients with ≈ 5% back-exchange.
- Dual enzyme columns allow complex protein/glycan digestion schemes.
- LC carryover is minimized by cleaning the protease and analytical columns with 4 quaternary LC pumps.
- Publically-available schematics allow fabrication of this system through 3D printing and robotic machining.



HPLC mounted on robotic rail of the HDX-MS system.

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NIST Cold (-30 °C) HPLC for HDX-MS

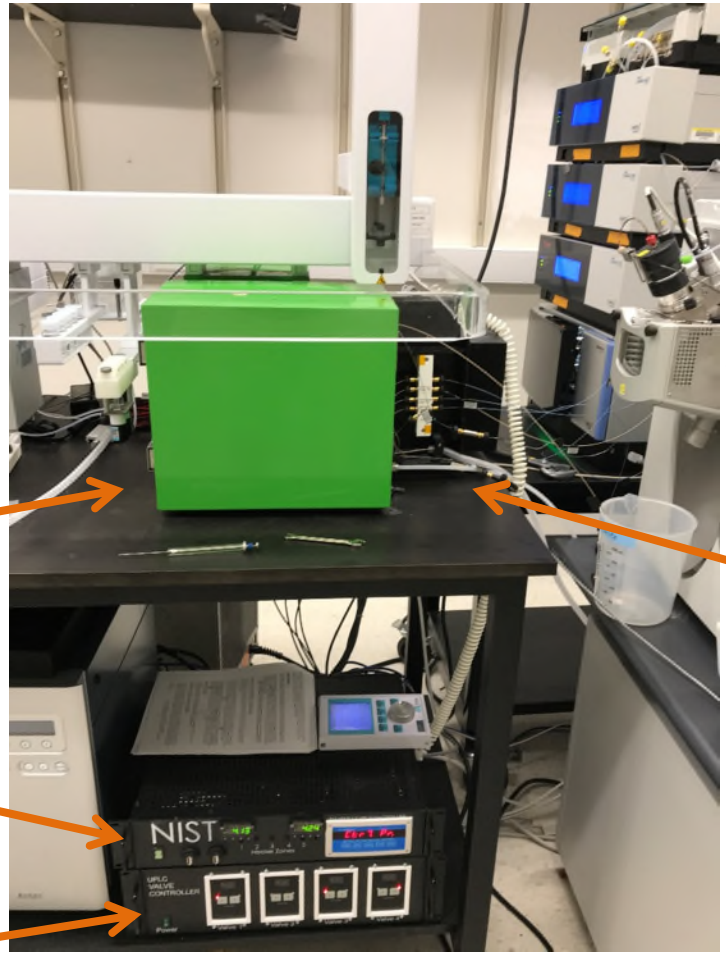

Figure: View of the HPLC installed onto a LEAP PAL rail.

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Features of the NIST Cold HPLC

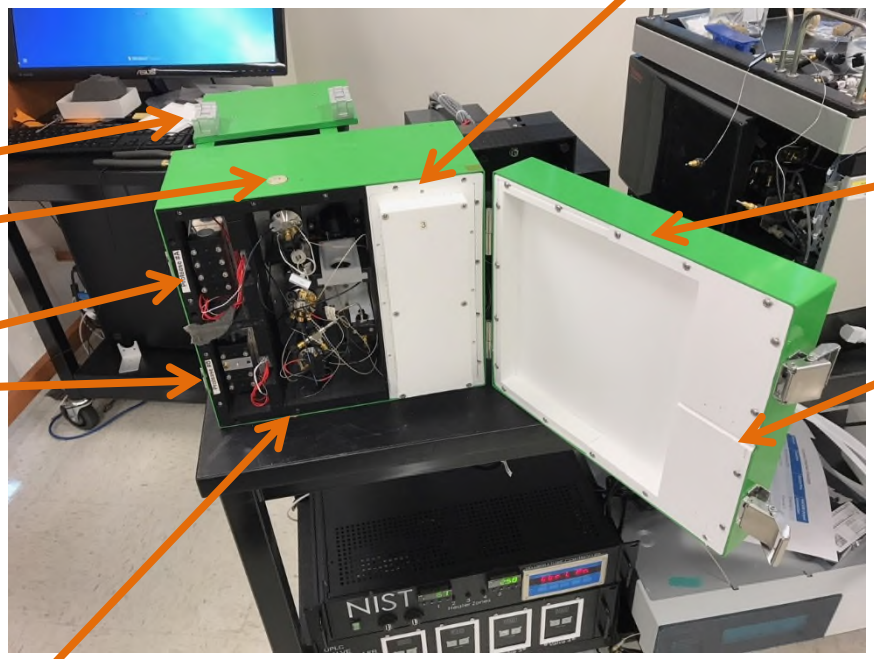

Figure: View of the opened HPLC on its test stand.

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Backside view of NIST HPLC

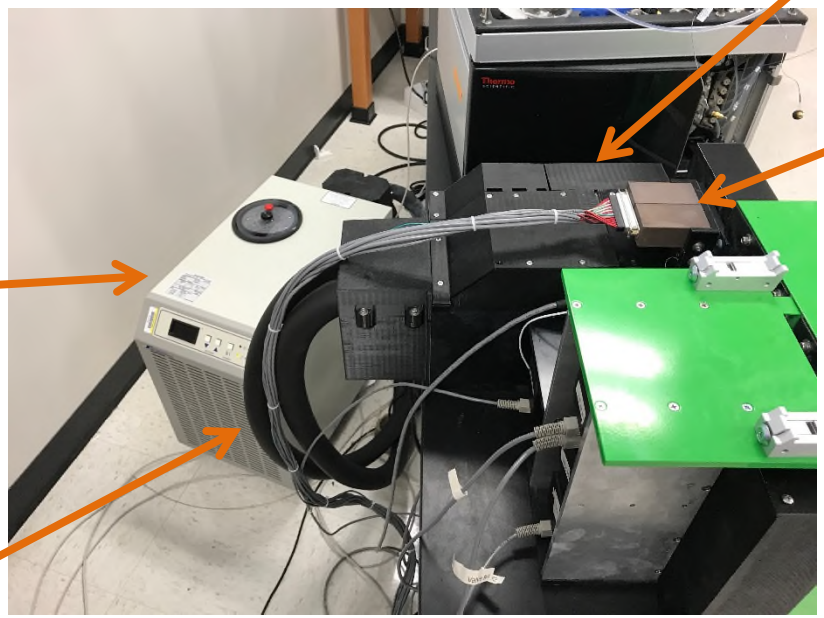

Figure: Backside view of the HPLC on its test stand.

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Rear View of NIST HPLC

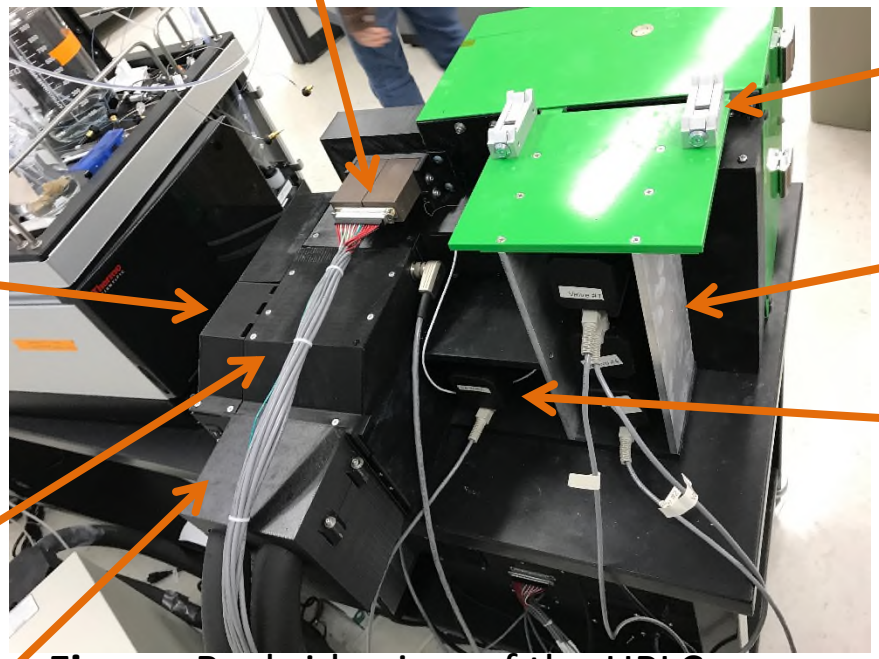

Figure: Backside view of the HPLC on its test stand.

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Detailed View of Protease Stages

For temperature stability 4 clamps hold the protease column collet assembly

Groove passes cable For reducing cell.

For temperature stability each protease column is placed into a collet adapter & the assembly is clamped to the stage.

Each protease stage pulls out on linear bearings

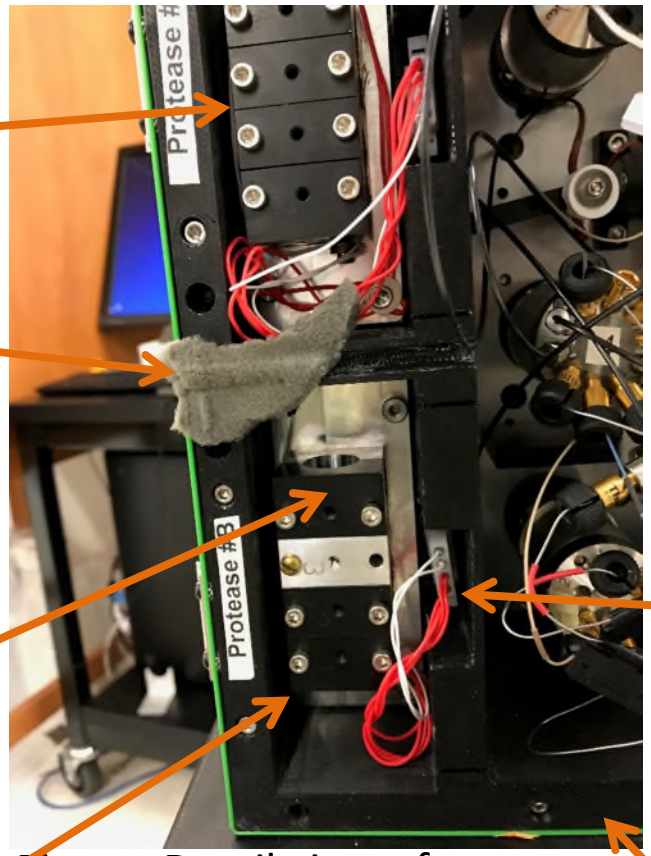

Figure: Detail view of protease chambers. Temperature of each protease stage is independently selected and controlled.

4-contact plastic connector for heater and sensor circuits. (Female connector is panel-mounted to 3-D printed mask

3-D printed (PLA) mask

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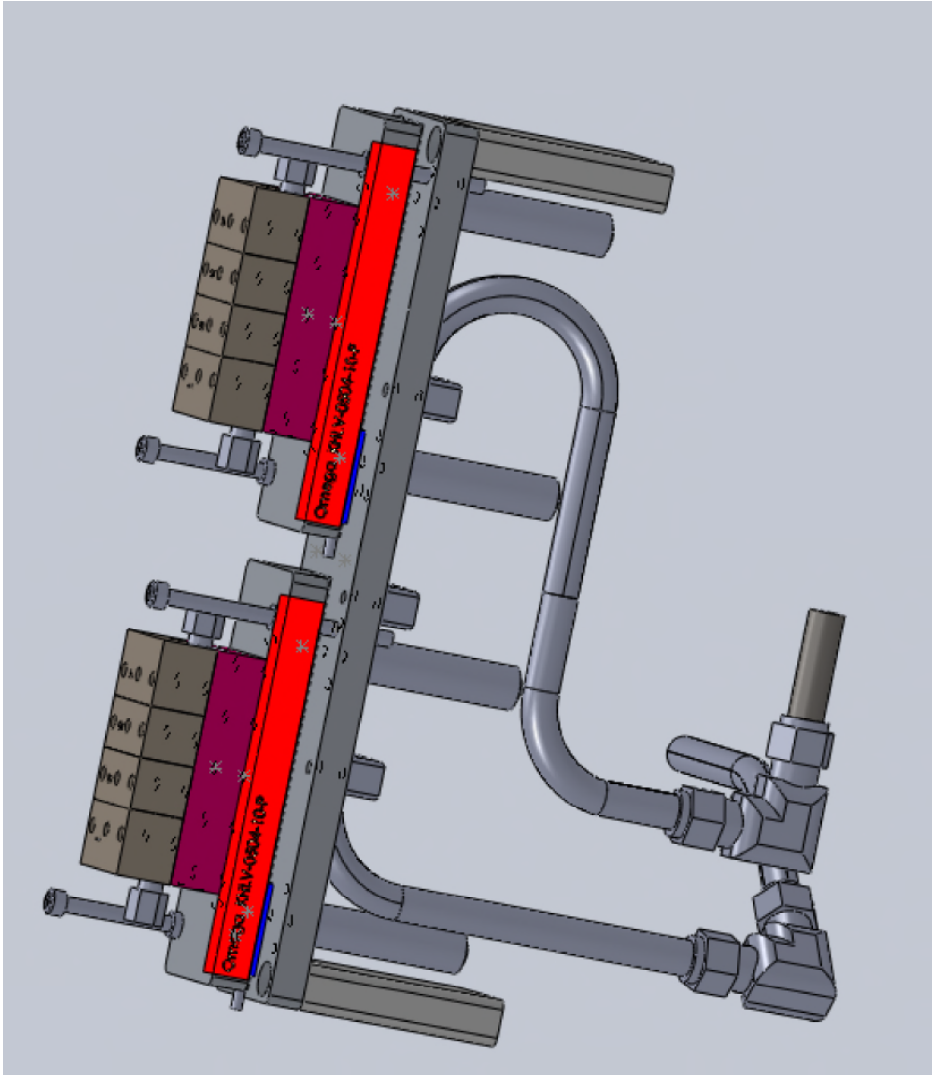
View of Protease columns on extendable mounts with Kapton heating Strips



View of Protease columns on extendable mounts with Kapton heating Strips. (Thermister and additional heaters are on underside of each cassette.

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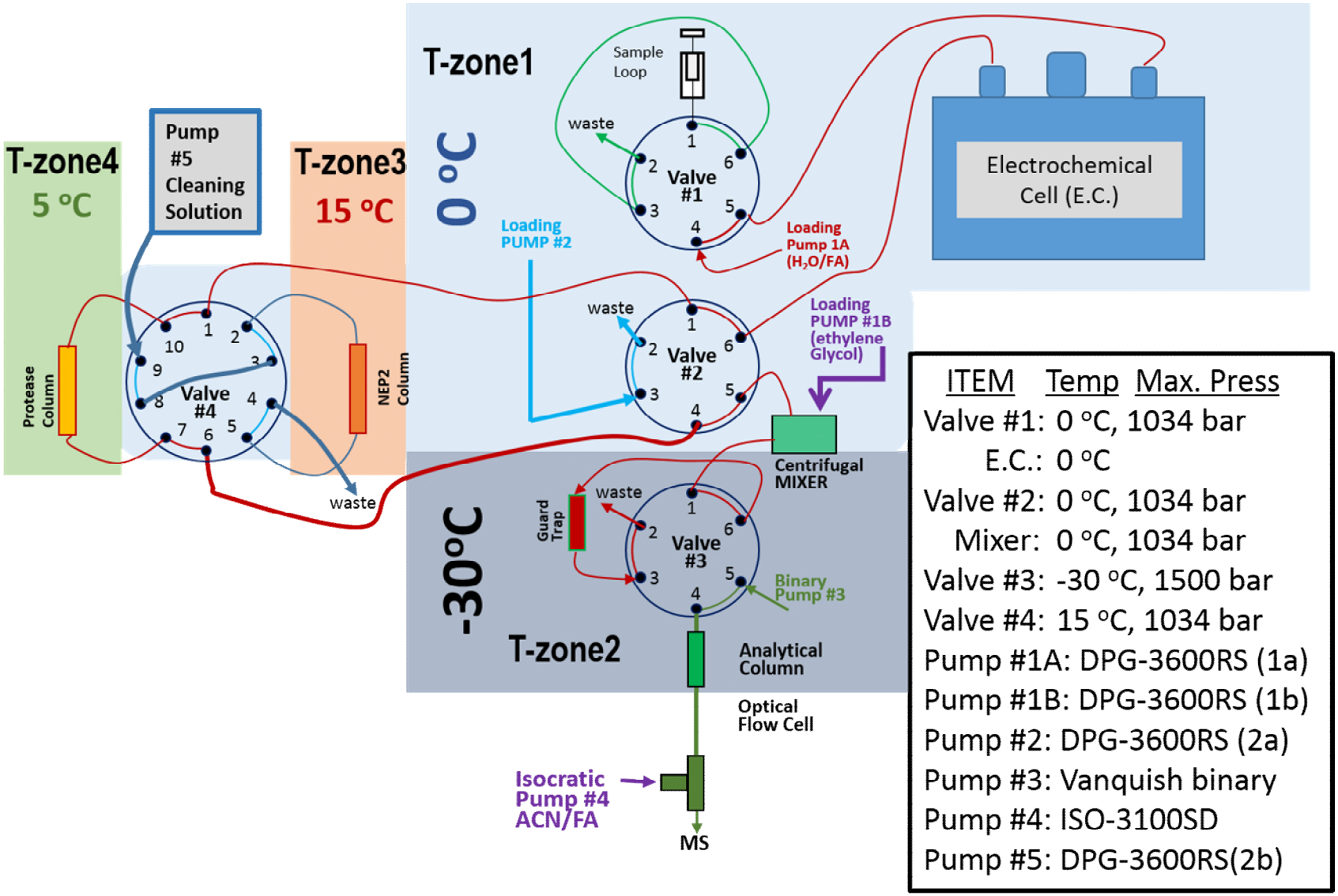
Overview of the HPLC Fluidic System



ITEM	Temp	Max. Press
Valve #1:	0 °C,	1034 bar
E.C.:	0 °C	
Valve #2:	0 °C,	1034 bar
Mixer:	0 °C,	1034 bar
Valve #3:	-30 °C,	1500 bar
Valve #4:	15 °C,	1034 bar

Pump #1A: DPG-3600RS (1a)
Pump #1B: DPG-3600RS (1b)
Pump #2: DPG-3600RS (2a)
Pump #3: Vanquish binary
Pump #4: ISO-3100SD
Pump #5: DPG-3600RS(2b)

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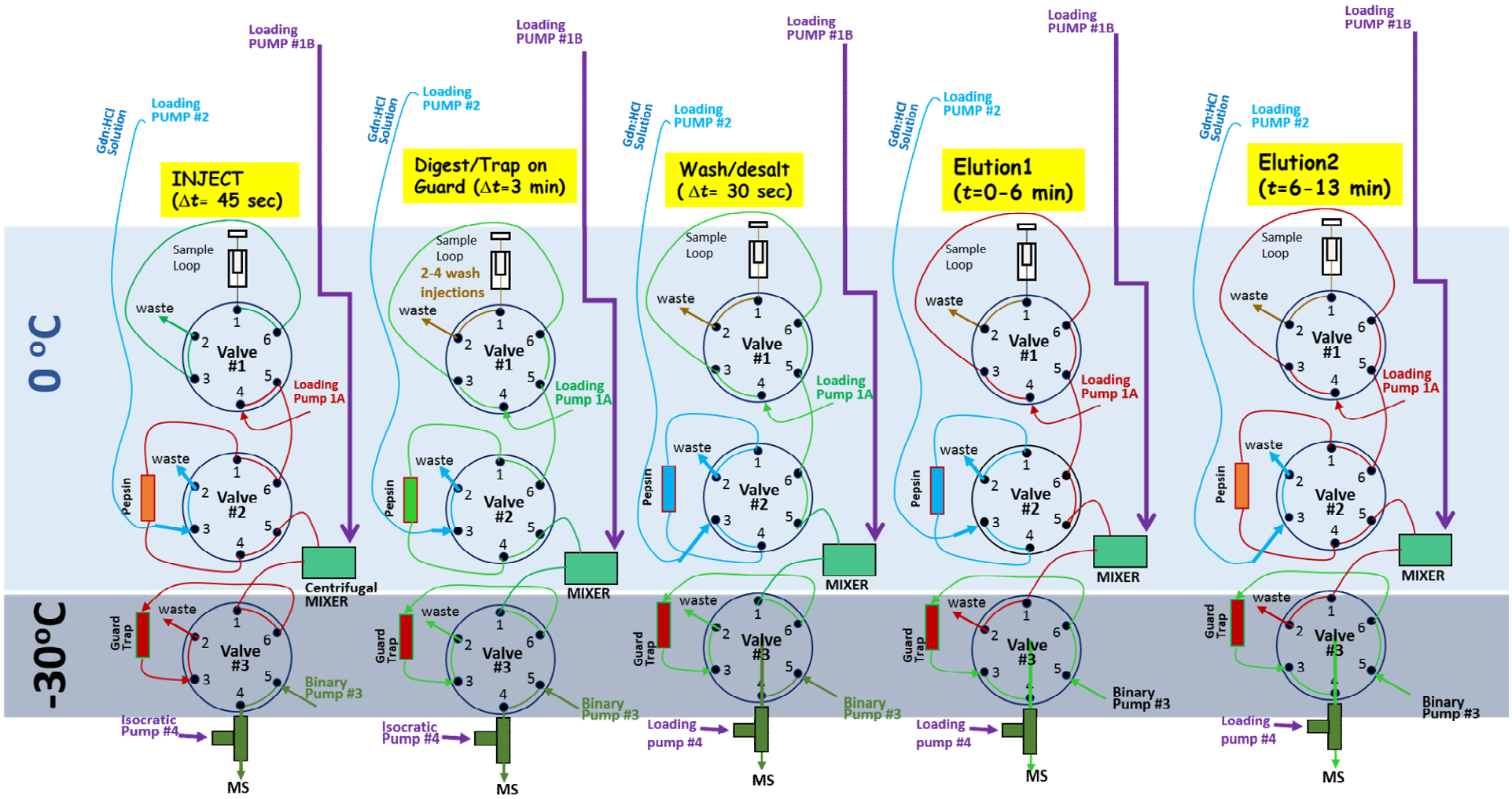
Valve States During Proteomic Analyses

-- Valve 4 is not shown, but in this diagram it would be in the position of the pepsin column.



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Analytic Fluidic Circuits of the HPLC

Connection #	Circuit	Function	Valve	Port	Pressure	Off Valve Location	Length (mm)	Connector
1	1	Injection to sample loop	1	1	nil		0	External port injection shaft
2	1	Sample loop (in)	1	6	10K		50 uL loop	Regular
3	1	Sample loop out)	1	3	10k		50 uL loop	Regular
4	1	waste	1	2	10K	Acc. Box Waste Port	713.994	Regular (one end only)
5	2	Loading Pump 1A (H2O/FA) source	1	4	10K	Acc. Box Union #5	**713.994**	nanoViper to nanoViper
6	2	Source to Electrochem Cell	1	5	10K	Electrochem Cell or V2, p6		nanoViper to nanoViper
7	2	Electrochem Cell to V2	2	6	10K	Electrochem Cell or V2, p6		nanoViper to nanoViper
8	2	source to Valve #4	2	1	10K	Valve #4, p1		nanoViper to nanoViper
9	2	Loading Pump #2A (H2O/FA) source	2	3	10K	Acc. Box Union #2	**611.886**	nanoViper to nanoViper
10	2	Waste	2	2	nil	Acc. Box Waste Port	**611.886**	Regular (one end only)
11	3	Valve #4 (out)	2	4	10K			nanoViper to nanoViper
12	3	Valve #2 (out)	2	5	10K	To mixer Tee		nanoViper to nanoViper
13	4	Loading Pump 1B (EG/MeOH/FA) source	--	--		Acc. Box Union #3 to Mixer Tee	**625.856**	nanoViper to nanoViper
14	4	Mixer (out) to valve #3	3	1	10K	Mixer		nanoViper to nanoViper
15	4	source to guard trap	3	6	22K	guard trap		nanoViper to nanoViper
16	4	guard trap (out) to V#4	3	3	22K	guard trap		nanoViper to nanoViper
17	4	waste	3	2	10K	Acc. Box Waste Port		Regular (one end only)
18	5	Binary Pump #3 (EG/MeOH/H2O/FA) source	3	5	22K	Acc. Box Union #1	**556.006**	nanoViper to nanoViper
19	5	To Analytical column	3	4	22K	Analytical column		nanoViper to nanoViper
20	5	Analytical column	--	--	10K	Acc box mixer Tee		nanoViper to nanoViper
21	6	Isocratic Pump #4 (H2O/MeOH/FA) source	--	--	10K	Acc. Box Union #6		nanoViper to nanoViper
22	6	Acc box mixer Tee	--	--	10K	Mass Spectrometer		nanoViper to nanoViper
23	7	Sample In from V2, P1	4	1	10K	V2, P1		nanoViper to nanoViper
24	7	out to Proteolysis Column #1	4	10	10K	Proteolysis Column #1		nanoViper to nanoViper or Regular/Waters
25	7	in from Proteolysis Column #1	4	7	10K	Proteolysis Column #1		nanoViper to nanoViper or Regular/Waters
26	7	Prot Column (Out)	4	6	10K	to V2, P4		
27	8	Loading Pump #2B (H2O/FA) source	4	9	10K	Acc. Box Union #4	**662.432**	nanoViper to nanoViper
28	9	Bridge (out)	4	8	10K	V4,P3		nanoViper to nanoViper
29	9	Bridge (in)	4	3	10K	V4,P8		
30	9	Out to Protease Column #2	4	2	10K	Protease Column #2 (in)		nanoViper to nanoViper or Regular/Waters
31	9	From Protease Column #2	4	5	10K	Protease Column #2 (out)		nanoViper to nanoViper or Regular/Waters
32	9	Waste	4	4	10K	Acc. Box Waste Port	662.432	Regular (one end only)

Connection #	Circuit	Function	Valve #	Port	Pressure	Off Valve Location	Length (mm)		Connector
SOURCE LINES									
18	5	Binary Pump #3 (EG/MeOH/H2O/FA) source	**3**	5	22K	Acc. Box Union #1	556		nanoViper to nanoViper
9	2	Loading Pump #2A (H2O/FA) source	**2**	3	10K	Acc. Box Union #2	612		nanoViper to nanoViper
13	4	Loading Pump 1B (EG/MeOH/FA) source	**--**	--		Acc. Box Union #3 to Mixer Tee	626		nanoViper to nanoViper
27	8	Loading Pump #2B (H2O/FA) source	**4**	9	10K	Acc. Box Union #4	662		nanoViper to nanoViper
5	2	Loading Pump 1A (H2O/FA) source	**1**	4	10K	Acc. Box Union #5	714		nanoViper to nanoViper
WASTE								**L (in)**	
4	1	waste	**1**	2	10K	Acc. Box Waste Port	714	28.1	Regular (one end only)
10	2	Waste	**2**	2	nil	Acc. Box Waste Port	612	24.1	Regular (one end only)
17	4	waste	**3**	2	10K	Acc. Box Waste Port	556	21.9	Regular (one end only)
32	9	Waste	**4**	4	10K	Acc. Box Waste Port	662	26.1	Regular (one end only)

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Capillary Circuit & Part Numbers

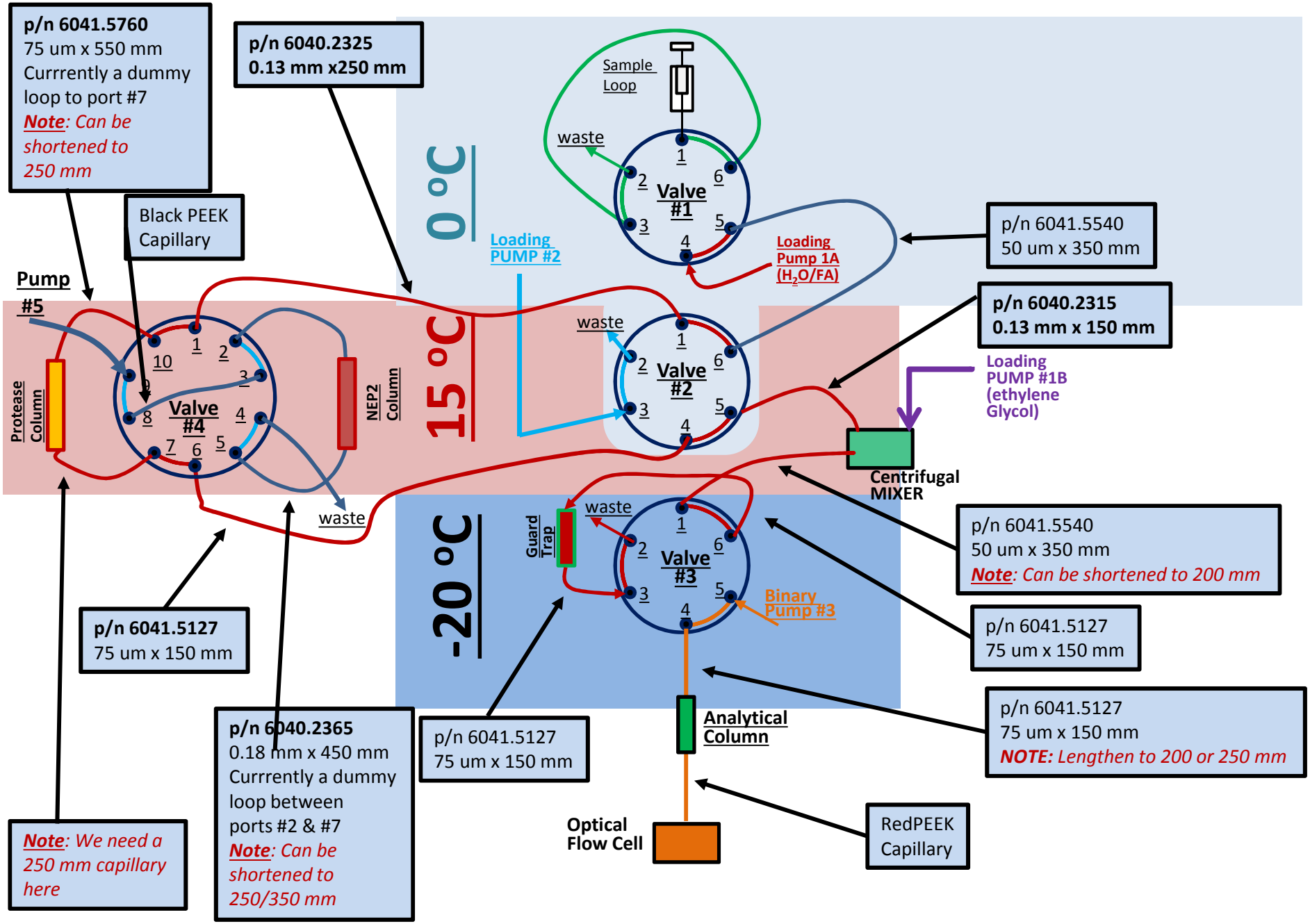

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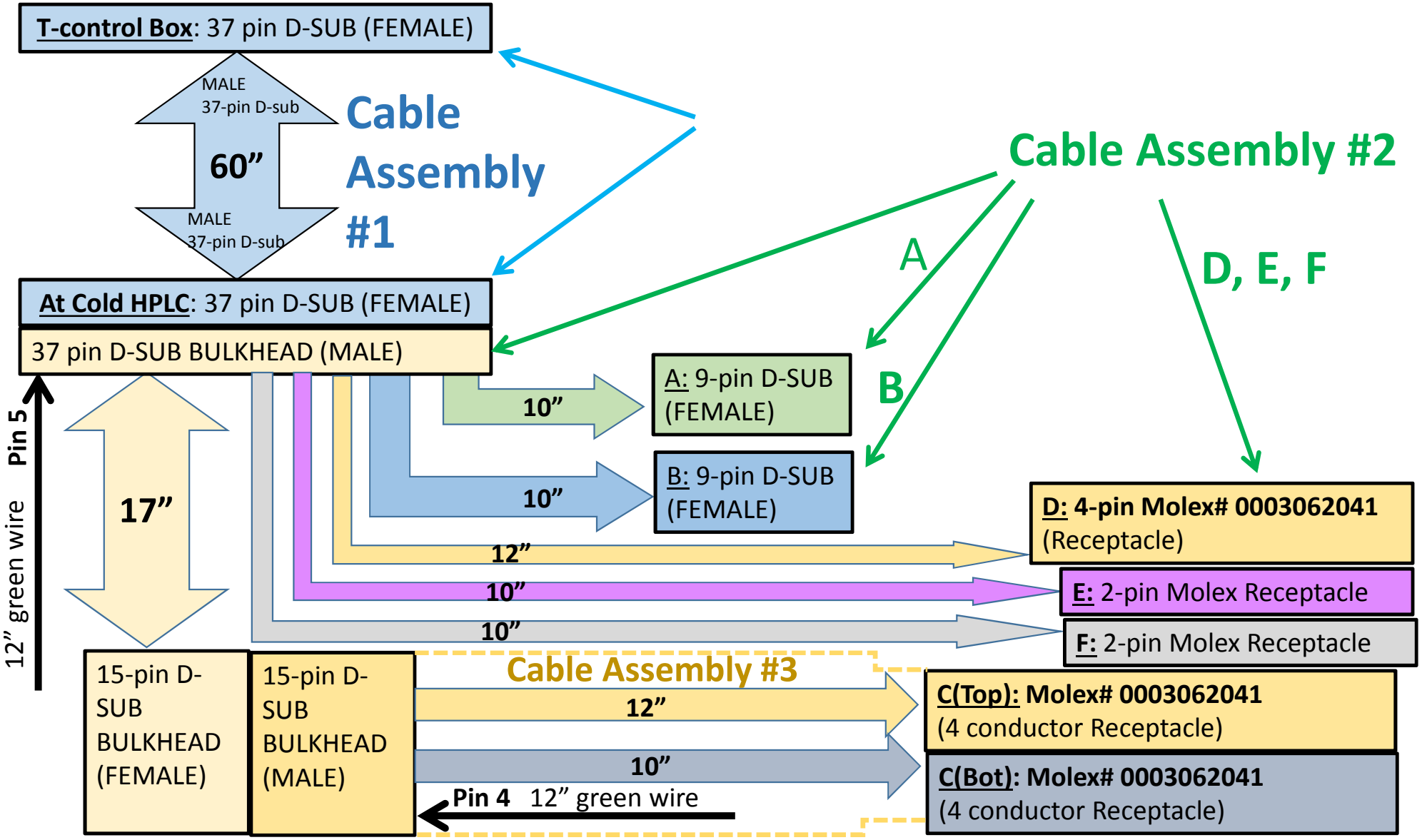
Diagram of the electrical Cable Assignments (Unverified)



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Heater & Sensor Wiring Table

ZONE	FUNCTION	37-PIN CONNECTOR	LENGTH & WIRE GAUGE (IN)	TERMINATINGFEMALE CONNECTOR (PINS)	MALECONNECTOR (PINS)	TERMINATINGType
A (-30°C)	Thermistor1(+) Thermistor1(-) Heater1(+) Heater1(-) Fan1(+) Fan1(-) Ground			**9-pin SubD Female (A)** **1** **6** **2, 7** **3, 8** **5** **9** **8**	**9-pin SubD Male (A)** **1** **6** **2, 7** **3, 8** **5** **9** **8**	
B	Thermistor2(+) Thermistor2(-) Heater2(+) Heater2(-) Fan2(+) Fan2(-) Ground			**9-pin SubD Female (B)** **1** **6** **2, 7** **3, 8** **5** **9** **8**	**9-pin SubD Male (B)** **1** **6** **2, 7** **3, 8** **5** **9** **8**	
C(top)	Thermistor3(+) Thermistor3(-) Heater3(+) Heater3(-) Ground			**15-pin DIN Female (C)** (Amphenol FCI Part# G17S1500110EU) **1** **9** **2, 10** **3, 11** **4**	**15-pin DIN Male (C)** (Amphenol FCI Part# DA15P064TXLF) **1** **9** **2, 10** **3, 11** **4**	**Plastic Male Connector (D)** (Molex Part# 0050291758) 1 2 3 4
C(Bot)	Thermistor4(+) Thermistor4(-) Heater4(+) Heater4(-)			**15-pin DIN Female (C)** **8** **15** **6, 13** **7, 14**	**15-pin DIN Male (C)** **8** **15** **6, 13** **7, 14**	
D	Thermistor5(+) Thermistor5(-) Heater5(+) Heater5(-) Ground			**Plastic Female Connector(D)** (Molex Part# 0003062041) 1 2 3 4	**Plastic Male Connector (D)** (Molex Part# 0050291758) **1** **2** **3** **4**	

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Commercial Parts used to Construct the NIST Cold HPLC (page 1/2)

Item #	Part #	Description	Vendor	QNTY	NOTES
		NOTE: Thermal sensors & heaters are listed on the T-controller parts list.			
1	Trajon_holder	Collet for Trajon Protease column	Shapeways	2	Item can be printed by any vendor that can print aluminum
2	Mixer Holder	Holder for EtGly/H2O solution mixer	Shapeways	1	Item can be printed by any vendor that can print aluminum
3	Mixer Clamp	Clamp for mixer holder	Shapeways	1	Item can be printed by any vendor that can print aluminum
4		12" x 48" x 10 mm Spaceloft® Blanket	http://buyaerogel.com/	1	Calculate what you need. See notes on this issue in the prints. See Table of Contents
5		12" x 48" x 5 mm Spaceloft® Blanket	http://buyaerogel.com/	1	Calculate what you need. See notes on this issue in the prints. See Table of Contents
6	Model# RS44CL0	RS Recirculating Chiller, provides about 285W @ -30 °C	SP Scientific, FTS Systems Thermal Products	1	Requires 208V, single phase.
7	RNE-0844	Arctic Tubing, 3/8" I.D, 1 foot by Good Year	SP Scientific, FTS Systems Thermal Products	8	
8	RUR-0803	Insulation Tube, 1 foot length, 3/4" I.D. x 3/8" Wall for Use with RNE-0844 Tubing	SP Scientific, FTS Systems Thermal Products	8	
9	60794	1/2" NPT HFC 35 Series Polysulfone Coupling Insert - Shutoff	United States Plastic Corp, www.usplastic.com	1	
10	60670	3/8" In-Line Hose Barb HFC 35 Series Polysulfone Coupling Body - Shutoff	United States Plastic Corp, www.usplastic.com	1	
11	60667	1/2" NPT HFC 35 Series Polysulfone Male Coupling Body - Shutoff	United States Plastic Corp, www.usplastic.com	1	
12	60797	3/8" In-Line Hose Barb HFC 35 Series Polysulfone Coupling Insert - Shutoff	United States Plastic Corp, www.usplastic.com	1	
13	SS-600-7-8	3/8" Swagelock x 1/2" Female NPT Straight	Dibert Valve & Fitting Co., Inc., http://dibert.swagelok.com	2	Used to interface with Polysulfone couplers
14	SS-810-3-6-6	Reducing Union Tee, 1/2 in. x 3/8 in. x 3/8 in. Tube OD, Swagelok Fittings	Dibert Valve & Fitting	2	Used in counterflow heat recapture assembly
15	SS-600-9	Union Elbow, 3/8 in. Tube OD, Swagelok Fittings	Dibert Valve & Fitting	12	
16	SS-T6-S-035-20	316/316L Stainless Steel Seamless Tubing, 3/8 in. OD x 0.035 in. Wall x 20 Feet	Dibert Valve & Fitting	1	You will need to get quote for this item.
17	SS-43GS6-LL	1-Piece 40G Series 2-Way Ball Valve, 1.5 Cv, 3/8 in. Swagelok Tube Fitting, Black Latch Lock Handle	Dibert Valve & Fitting	1	I have two in my system, and I believe only one is needed.
18	SS-600-SET	316 Stainless Steel Ferrule Set (1 Front Ferrule/1 Back Ferrule) for 3/8 in. Swagelok Tube Fitting	Dibert Valve & Fitting	10	If you are perfect, you won't need these. One mistake, you will likely need it. Order in multiples of 10.
19	93365A130	6.32 x 0.150" heat-set insert	McMaster-Carr	2	
20	93365A132	6-32 x 0.250" Heast-set Insert for Plastic	McMaster-Carr	2	
21	93365A122	4-40 Heat-set Insert for Plastics	McMaster-Carr	1	
22	93365A140	8-32 X 0.185" Heat-set Insert for Plastic	McMaster-Carr	2	
23	91253A145	6-32 x 5/16" Alloy Steel Hex Drive Flat Head Screw	McMaster-Carr	1	These work, but I don't like them. I recommend a Phillips head.
24	91253A146	Black-Oxide Alloy Steel Hex Drive Flat Head Screws	McMaster-Carr	1	These work, but I don't like them. I recommend a Phillips head.
25	20-2020-BLACK-FB, pa	Strut, 20mm x 20mm x 7.95in long, Tap M5 both ends, 6061 Alun	8020, Inc	3	www.8020.net 3

Not listed:
1. Hinge model
2. Swagelock adapter to Shell
3. D-sub connectors
4. 9-pin connector on side.
5. Wire types.
6. Swage SS Tube Fitting, Female Connector, 3/8 in. Tube OD x 1/2 in. Female NPT

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Commercial Parts used to Construct NIST Cold HPLC (page 2/2)

26	CS-52	4-40 "Silver-Grip" Set Screw	PIC design	10	http://www.pic-design.com/
27	B11-18	Sintered Bronze Flanged Bearing, 0.377 bore, 0.375 length	PIC design	4	
28	AlOL-6-2.80-0001	3/8" diameter, C-1060, PRECISION CASE HARDENED & GROUND	PIC design	4	Inexpensive custom part
29	4621	#8-32 416 Stainless Steel SOCKET HEAD SHOULDER SCREW, B=5/8"	PIC design	6	
30	Z1-2	retaining ring	PIC design	6	
31	Z1-1	retaining ring	PIC design	6	
32	4WDX4	LIFT-OFF HINGE, POLISHED, 1.97 X 1.26 IN, Left	THE OFFICE GROUP INC , http://www.theofficestore.c	2	
33	38DZ57	Socket Head Cap Screw A2 Stainless Steel, M5 Thread Dia., 45mm Length under Head, pkg/50	THE OFFICE GROUP INC	1	
34	2WB54	Socket Head Cap Screw, 18-8 Stainless Steel, #4 Thread Dia., 1/2" Length, pkg. 100	THE OFFICE GROUP INC	1	
35	5RVN5	Socket Head Cap Screw, Black Oxide Finish, 10-32 thread, 3/8 Thread Length, pkg/100	THE OFFICE GROUP INC	1	
36	22TU96	SHCS Standard 6-32x1/2 316 SS PK100 Socket Head Cap Screw , pkg/100	THE OFFICE GROUP INC	1	
37	22TU87	SHCS Standard 6-32x1/2 316 SS PK100 Socket Head Cap Screw , pkg/100	THE OFFICE GROUP INC	1	
38	3ZMV5	Round Standoff Female Nylon Screw Size #10-32 Outside Dia. 1/2 In Length , pkg/100	THE OFFICE GROUP INC	1	
39	6UKX1	Flat Washer Standard 316 Stainless Steel Finish Plain Fits Bolt Sizes #10, pkg/100	THE OFFICE GROUP INC	1	
40	2DNY1	Flat Washer Standard 316 Stainless Steel Finish Plain Fits Bolt Sizes 4, pkg/25	THE OFFICE GROUP INC	1	
41	2DNY2	Flat Washer Standard 316 Stainless Steel Finish Plain Fits Bolt Sizes 6, pkg/25	THE OFFICE GROUP INC	1	
42	C82VX-1676EH6	6-port Valco Cheminert valve, one vertical port, 15000 psi, 250 µm bore, 1/16" Fittings with EH series Microelectric Actuator and 6" Standoff Assembly	VICI Valco Instruments, www.vici.com	1	Valve #1
43	C82X-1670DEH6	10-port Valco Cheminert valve, 15000 psi, 250 µm bore, 1/16" Fittings with EH series Microelectric Actuator and 6" Standoff Assembly	VICI Valco Instruments, www.vici.com	1	Valve #4
44	C82X-1676EH6	6-port Valco Cheminert valve, 15000 psi, 250 µm bore, 1/16"" Fittings with EH series Microelectric Actuator and 6" Standoff Assembly	VICI Valco Instruments, www.vici.com	1	Valve #2
45	C82U-1676EH6-NIST	6-port Valco Cheminert valve, 22000 psi, 1/16" Fittings with EH series Microelectric Actuator and 6" Standoff Assembly	VICI Valco Instruments, www.vici.com	1	Valve #3
46	2020 part cut 7.87" long	strut 20mm x 20mm x 7.95in long, Tap M5 both ends, 6061 Aluminun	8020, Inc	3	www.8020.net
47	473-1122-ND	Grease Silver Conductive (MG Chemicals 8463-7G), 0.25 oz	Digikey	1	

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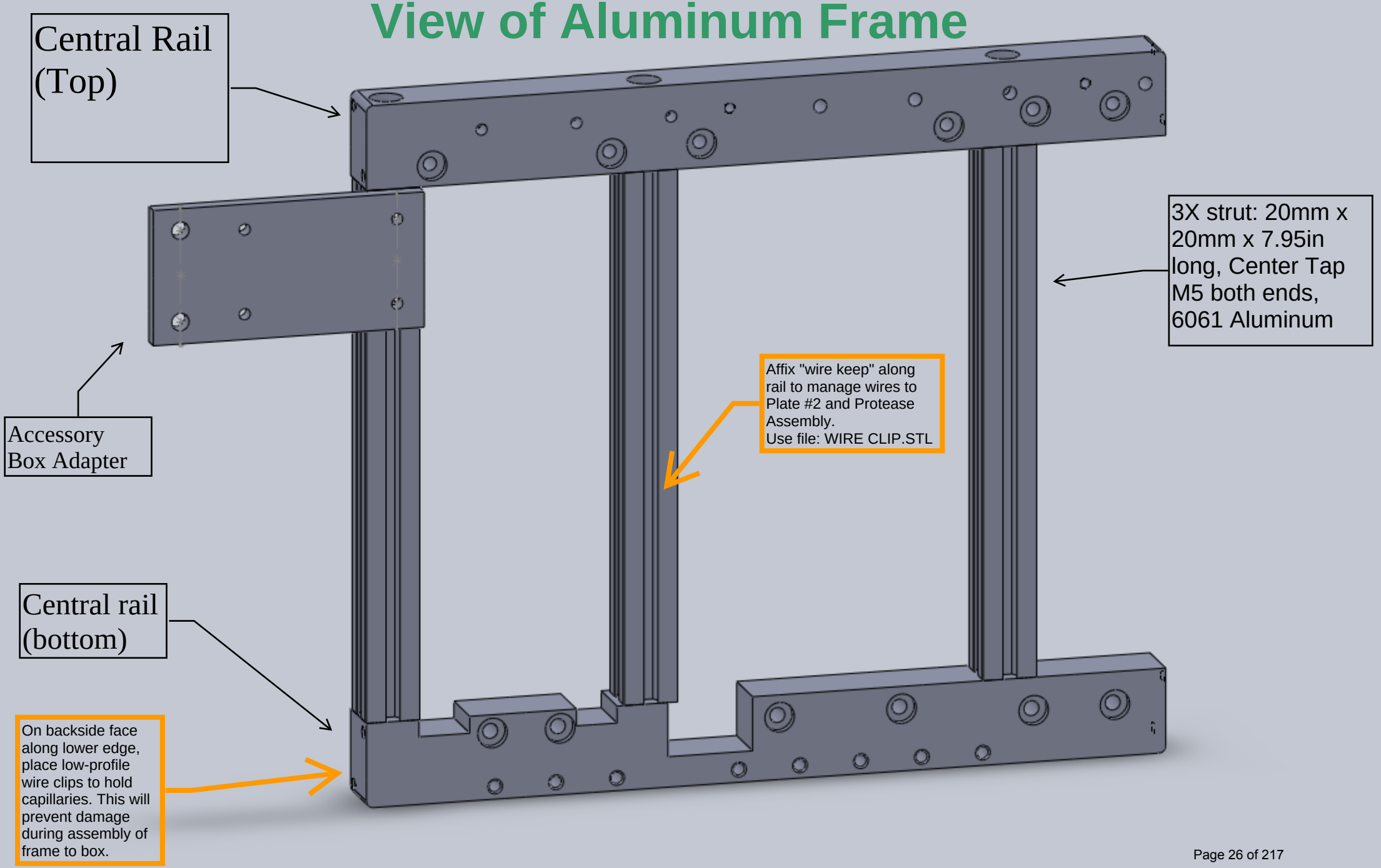
View of Aluminum Frame



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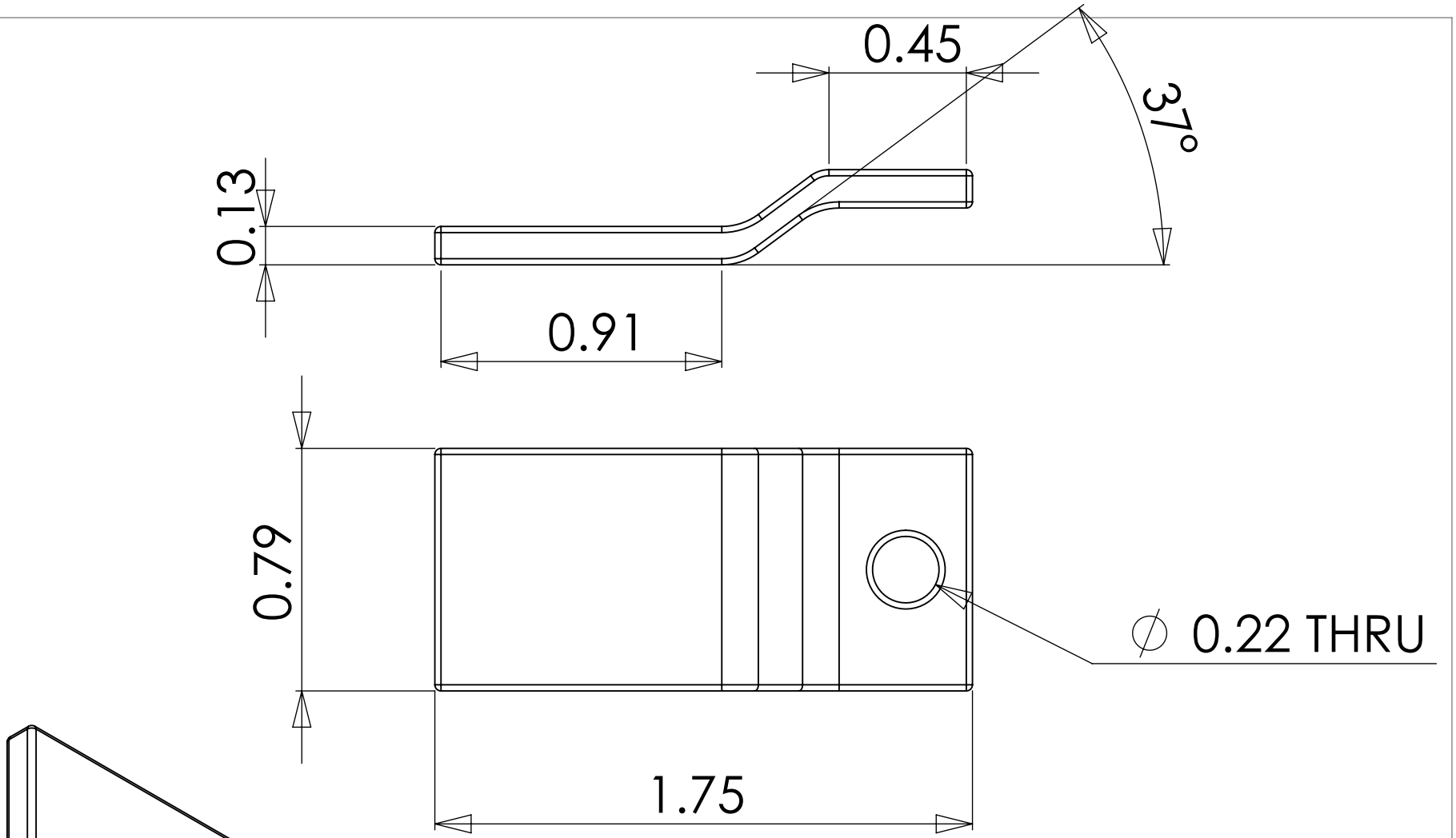

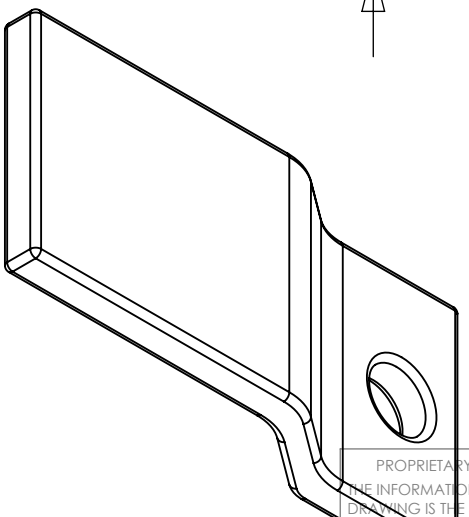

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL --

FINISH --

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

3D Print in PLA

Wire Keep

SIZE	DWG. NO.	REV.
A		

SCALE:2:1	WEIGHT:	SHEET 1 OF 1

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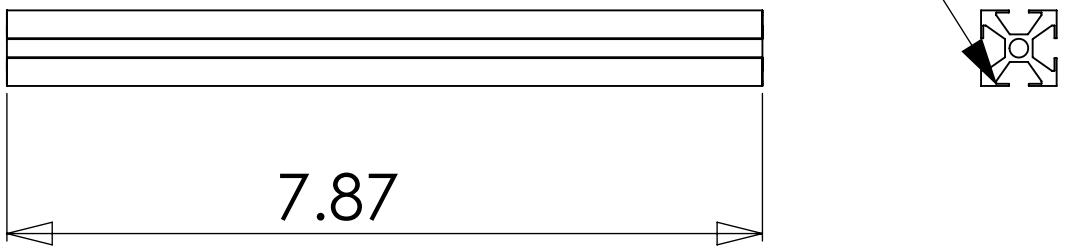
8020 part (8020.net)
Cat # 20-2020-BLACK



Make Three (3)

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			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
			COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

Frame Strut

SIZE	DWG. NO.	REV.
A		
SCALE:1:2	WEIGHT:	SHEET 1 OF 1

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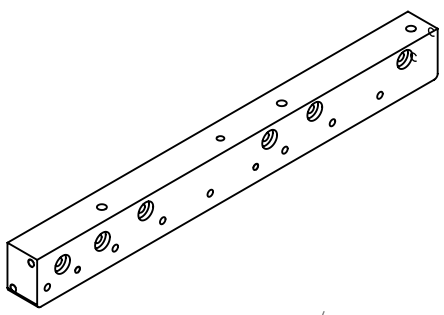

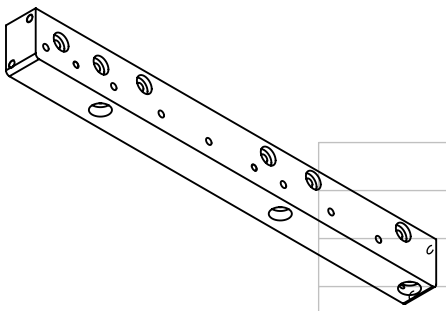

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:
Central Rail (Top)
[JWH:5-10-2016]

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

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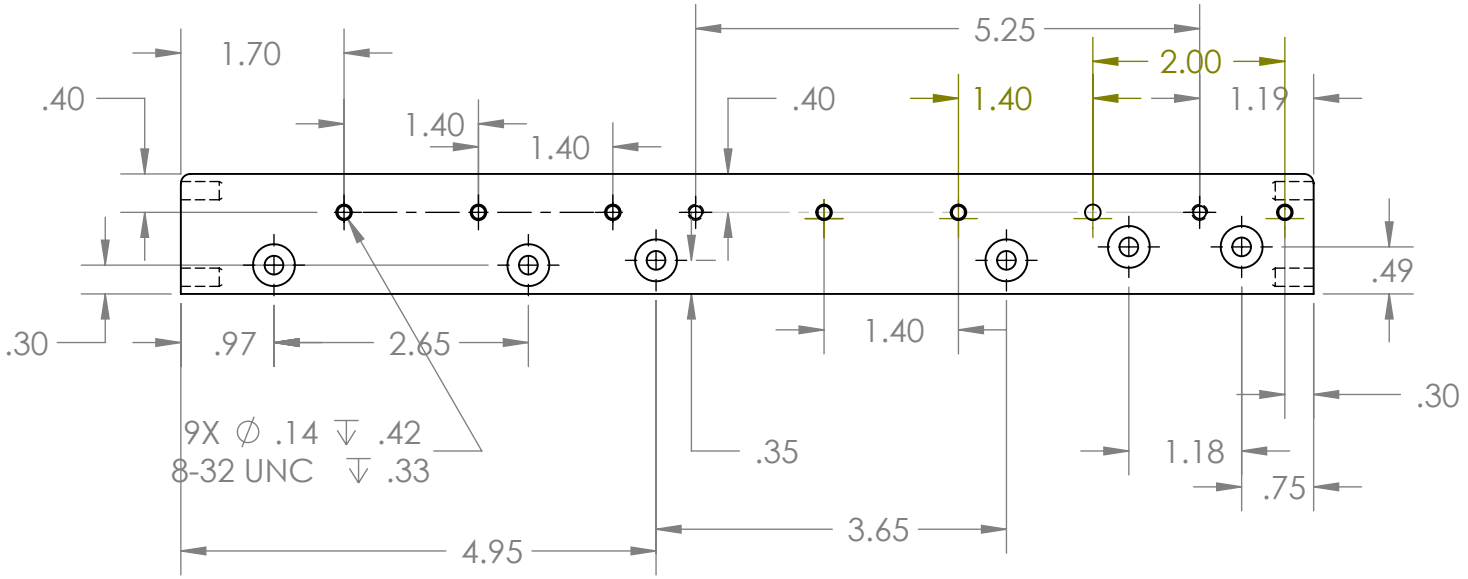

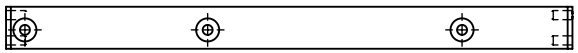

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Central Rail (Top) [JWH:5-10-2016]

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

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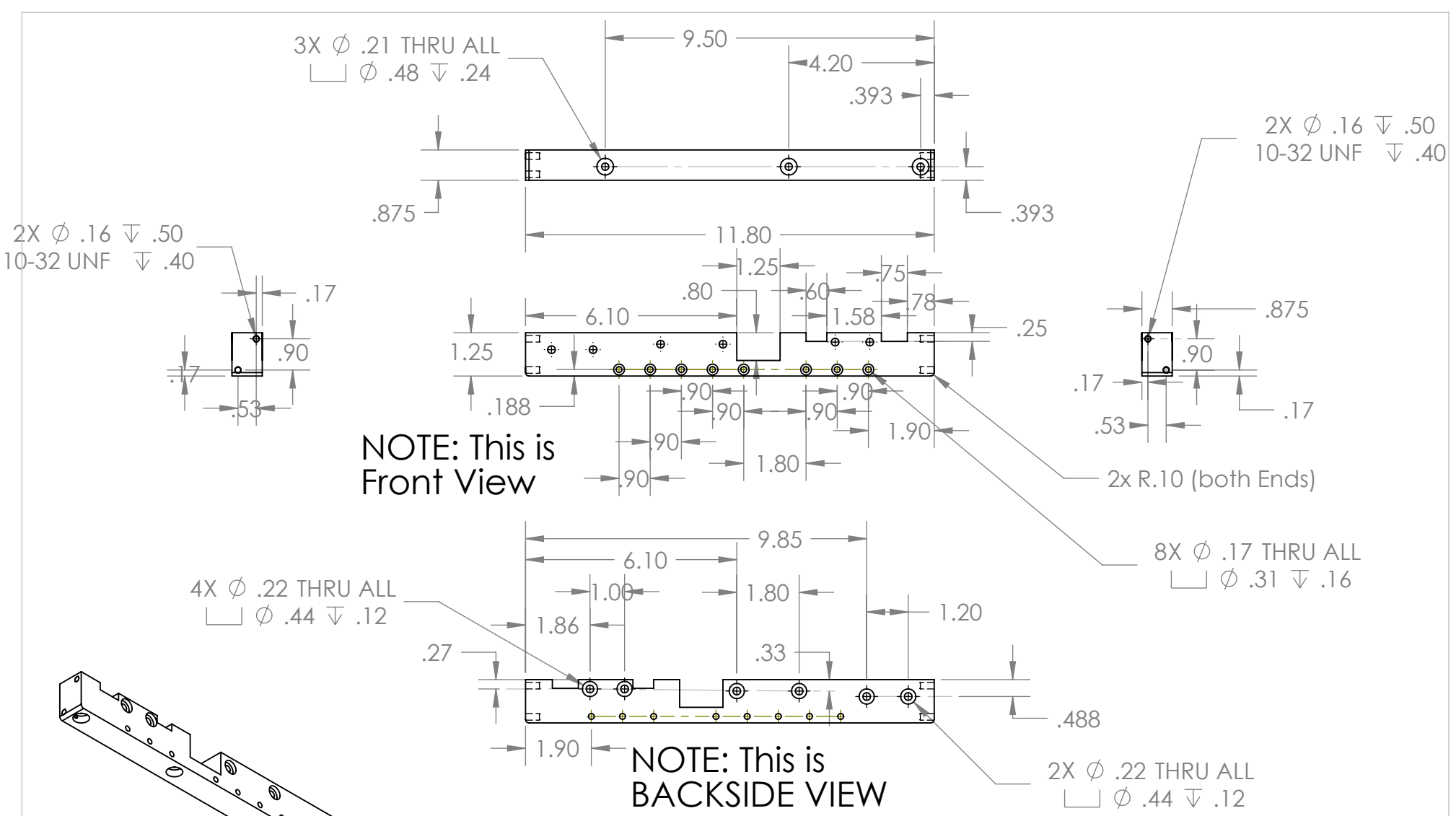

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:
Central rail (bottom)
[JWH: 5-10-2016]

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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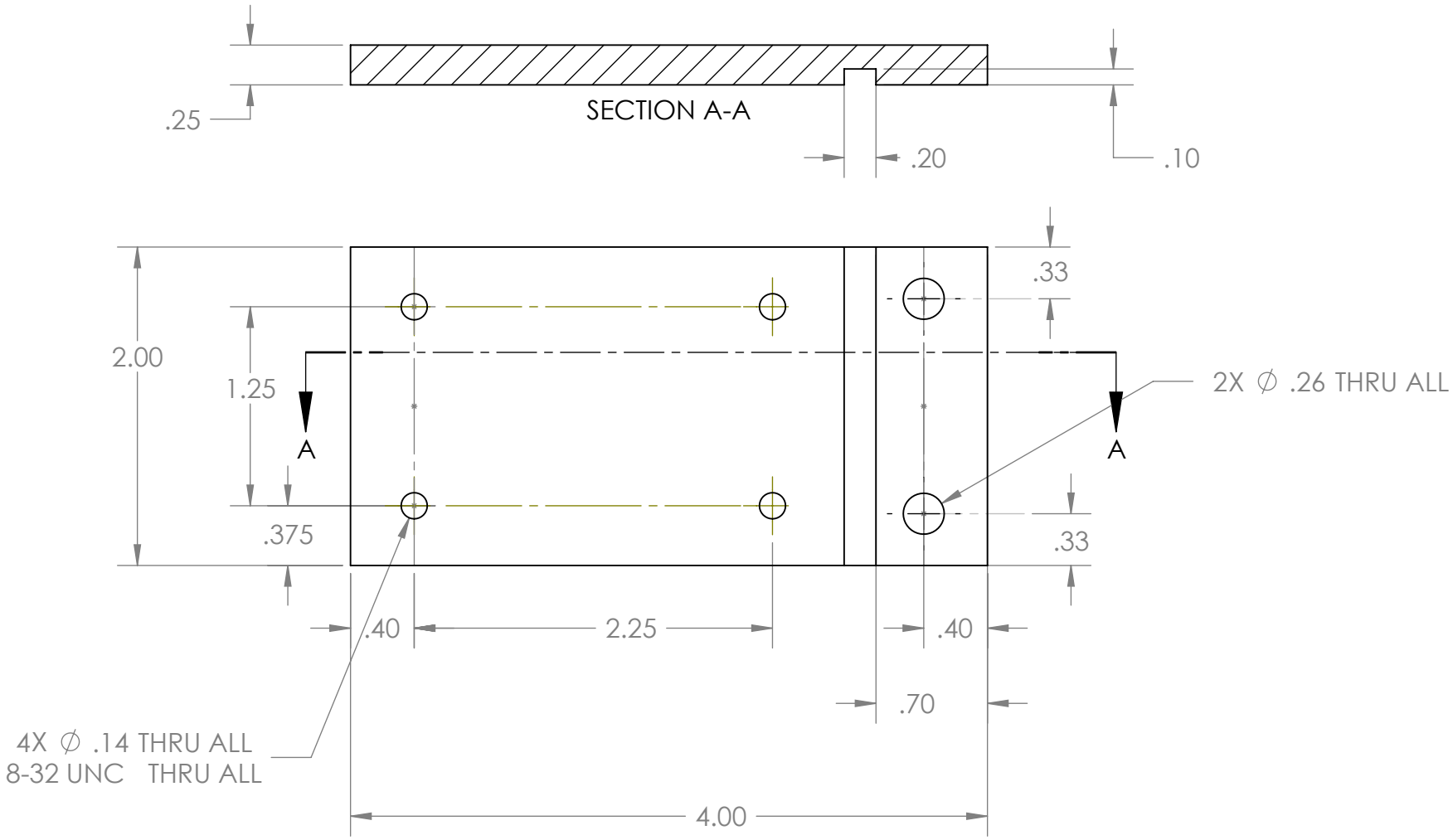

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:
Accessary Box Adapter
4-25-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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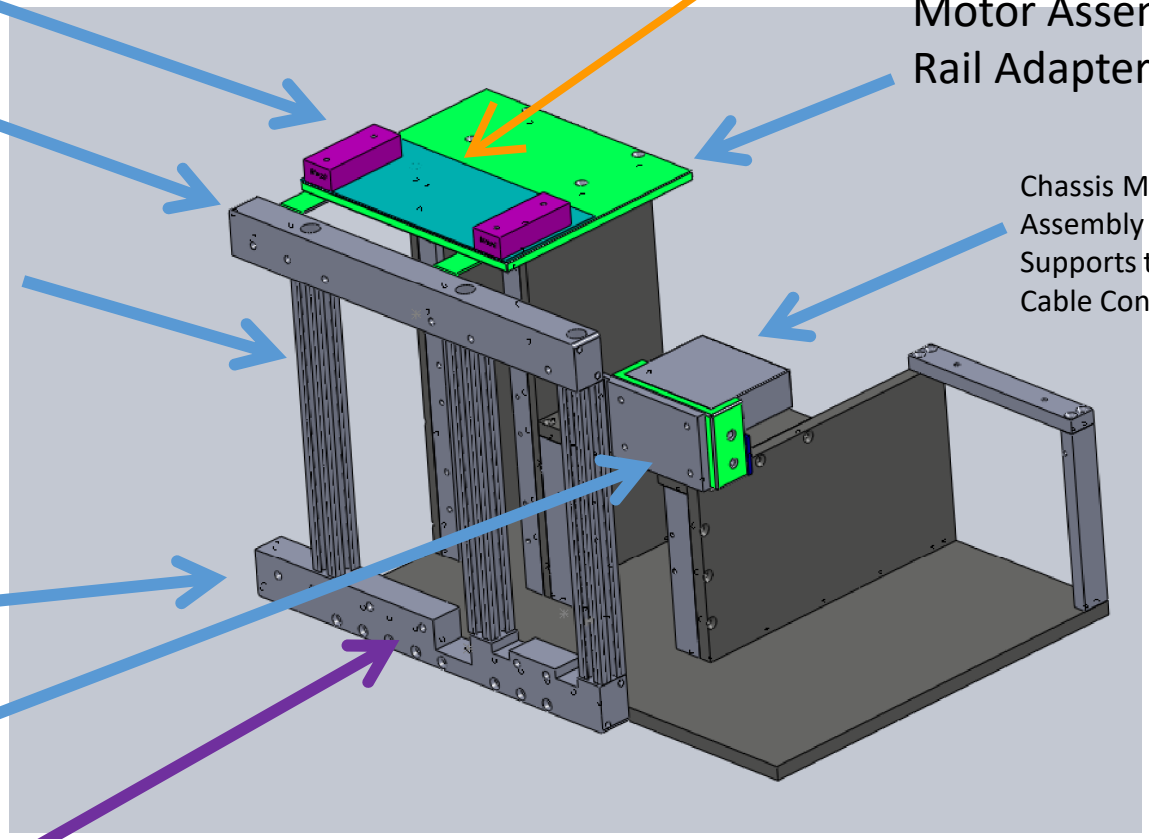
Overview of Metal Frame Assembly



The change in color is an artifact. Only one light green plate holds clamps. A sheet metal plate does lie beneath the light green top plate.

Purchase Rail Clamps From Vendor

Central Rail (top)

3X Fame Strut:

Part# 20-2020-BLACK-FB, 20mm x 20mm x 7.95in long, Tap M5 both ends, 6061 Aluminum (From 8020 Inc) Mount top/bottom rails using Socket Head Cap Screw A2 Stainless Steel, M5 Thread Dia., 45mm Length under Head

Central Rail (bottom)

Accessory Box Adapter

Motor Assembly to Rail Adapter

Chassis Mount Assembly that Supports the 37-pin Cable Connector

Mount to Motor Rail Base with 8-32 x 1. 5” long socket head screws

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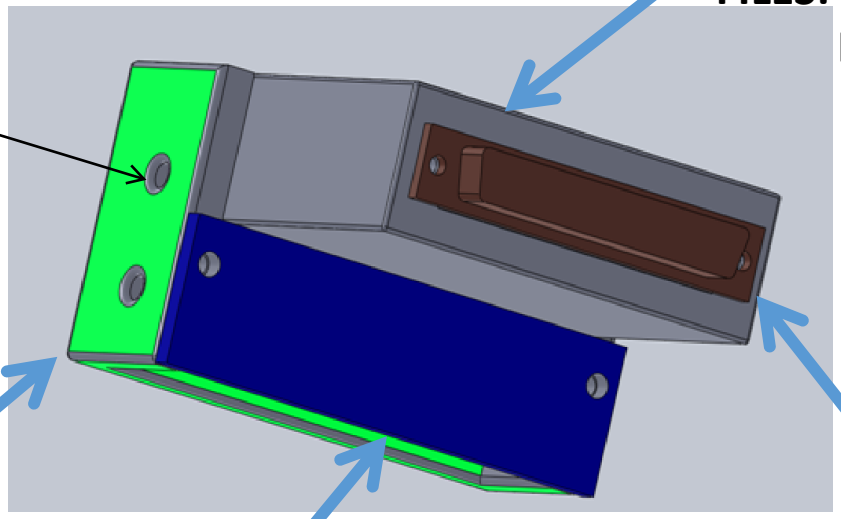
Chassis Mount Assembly that Supports the 37-pin Cable Connector

37-Pin D-sub Connector Mount (Print in Bronze-Steel
FILES: D-sub Mount(right).STL
D-sub Mount(LEFT).STL)

Mount *Connector Mount* using 4X 8-32 screws and nuts



Adapter to Accessory Box
(Mounts to "*Accessory Box Adapter*")
Mount with 1" 8-32 cap-head screws

Electrical Cover
(3D print: **Elect Cover.STL**)

Part# 999102, UPLCM Cable – Male DB37 Bulkhead Connector with Labeled 22 Gauge Two-wire and Four-wire Cable Assemblies with Flying Leads at the Ends (Ardara Technologies).

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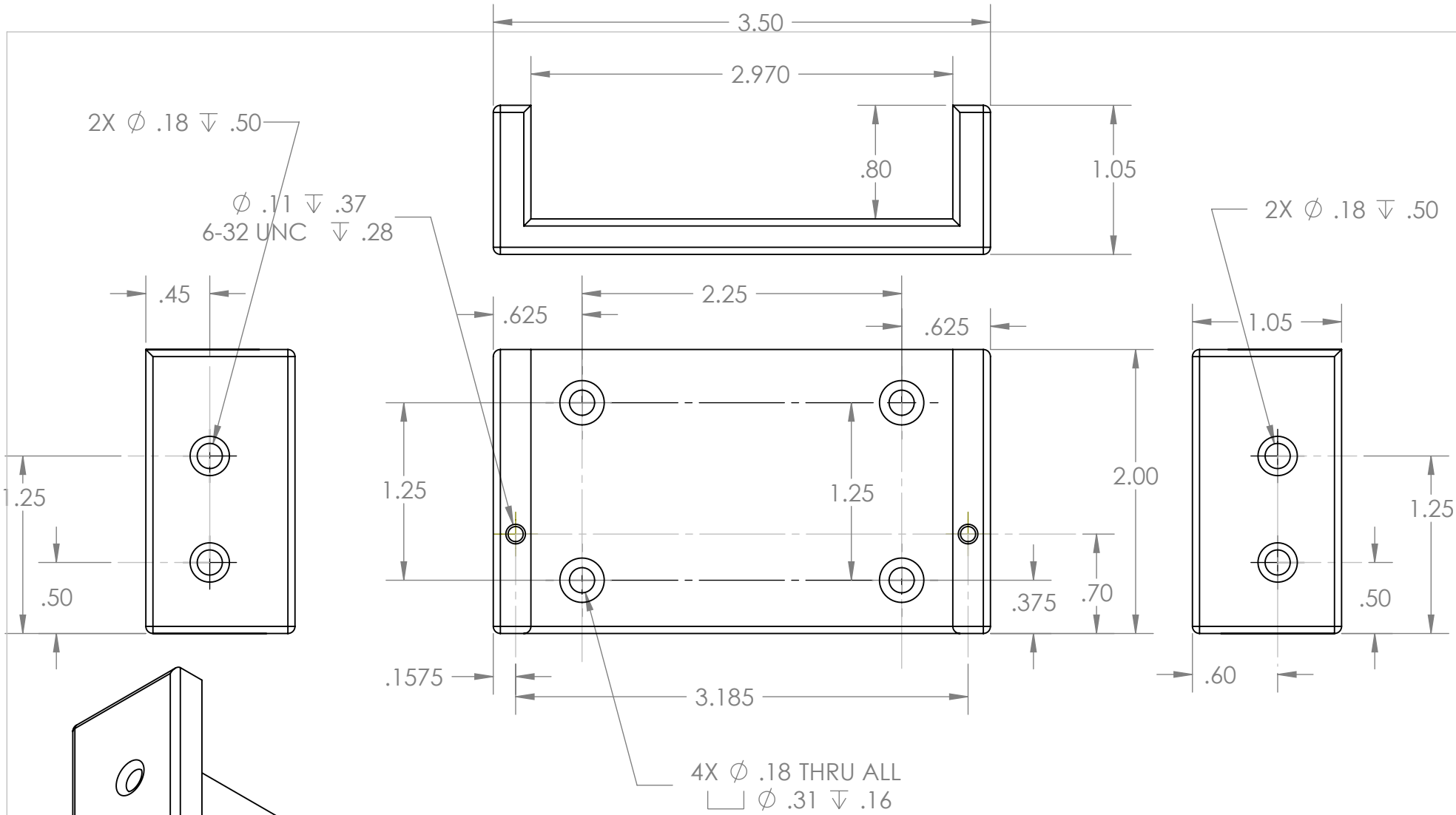

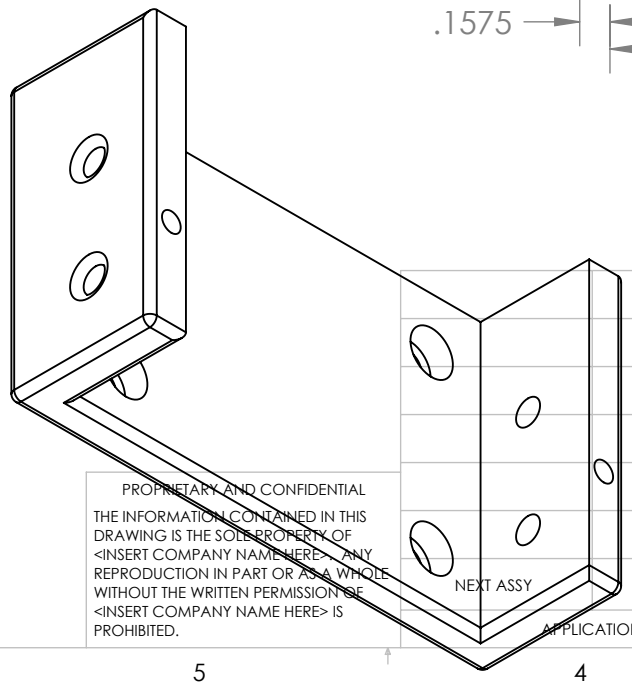

NEXT ASSY | USED ON | APPLICATION

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

TITLE:
Adapter to Accessory Box

SIZE	DWG. NO.	REV
A	Adapter to Accessary box ac	

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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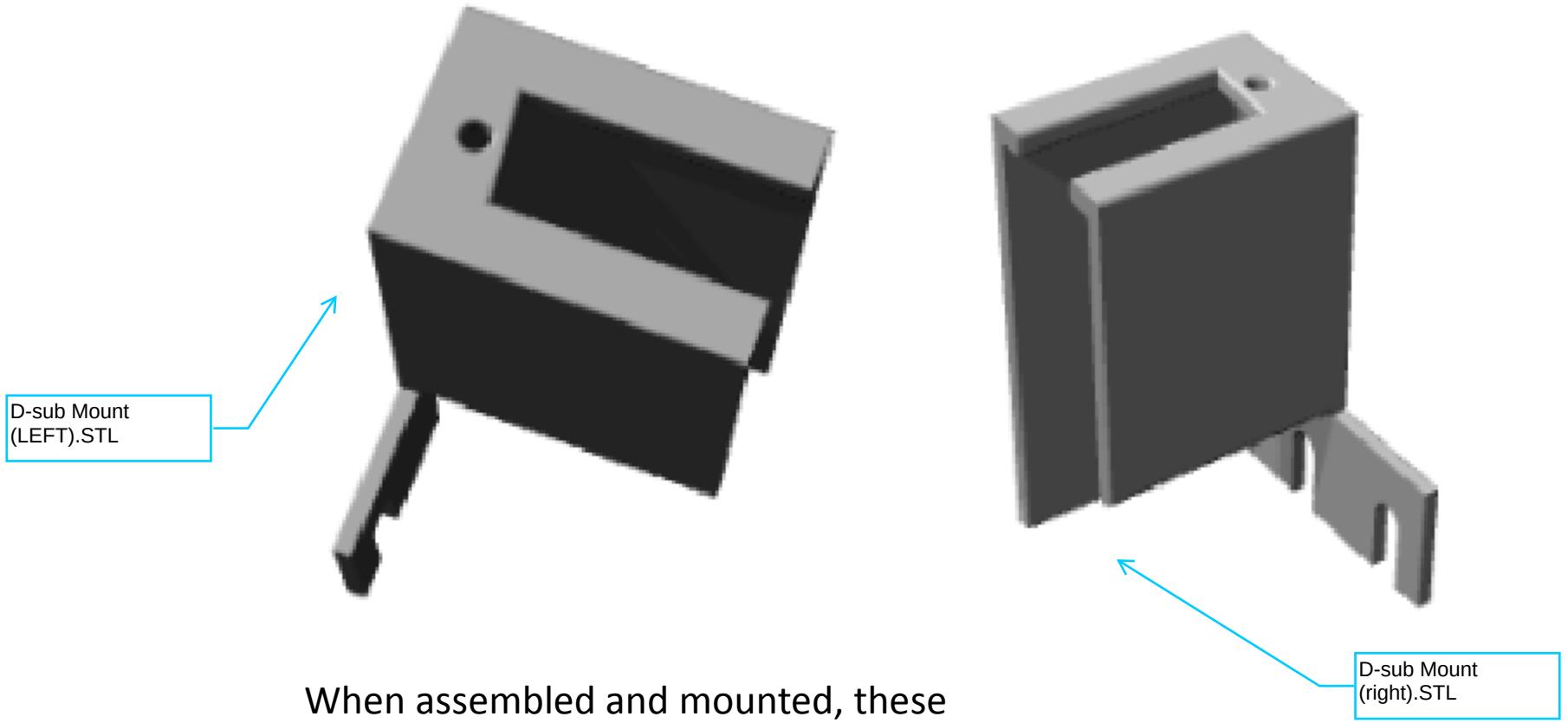
37-pin D-sub Connector Mount



When assembled and mounted, these parts are mechanically strong. I recommend sealing the seam.

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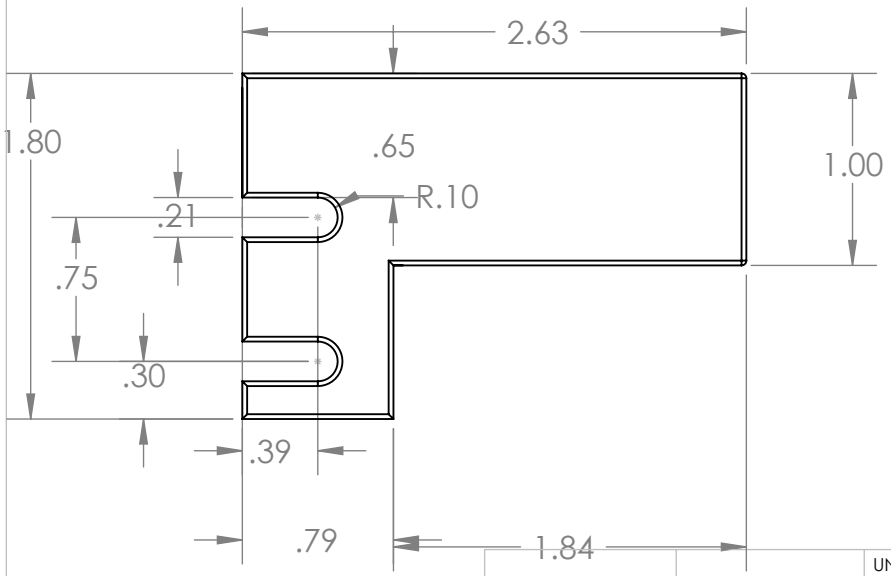

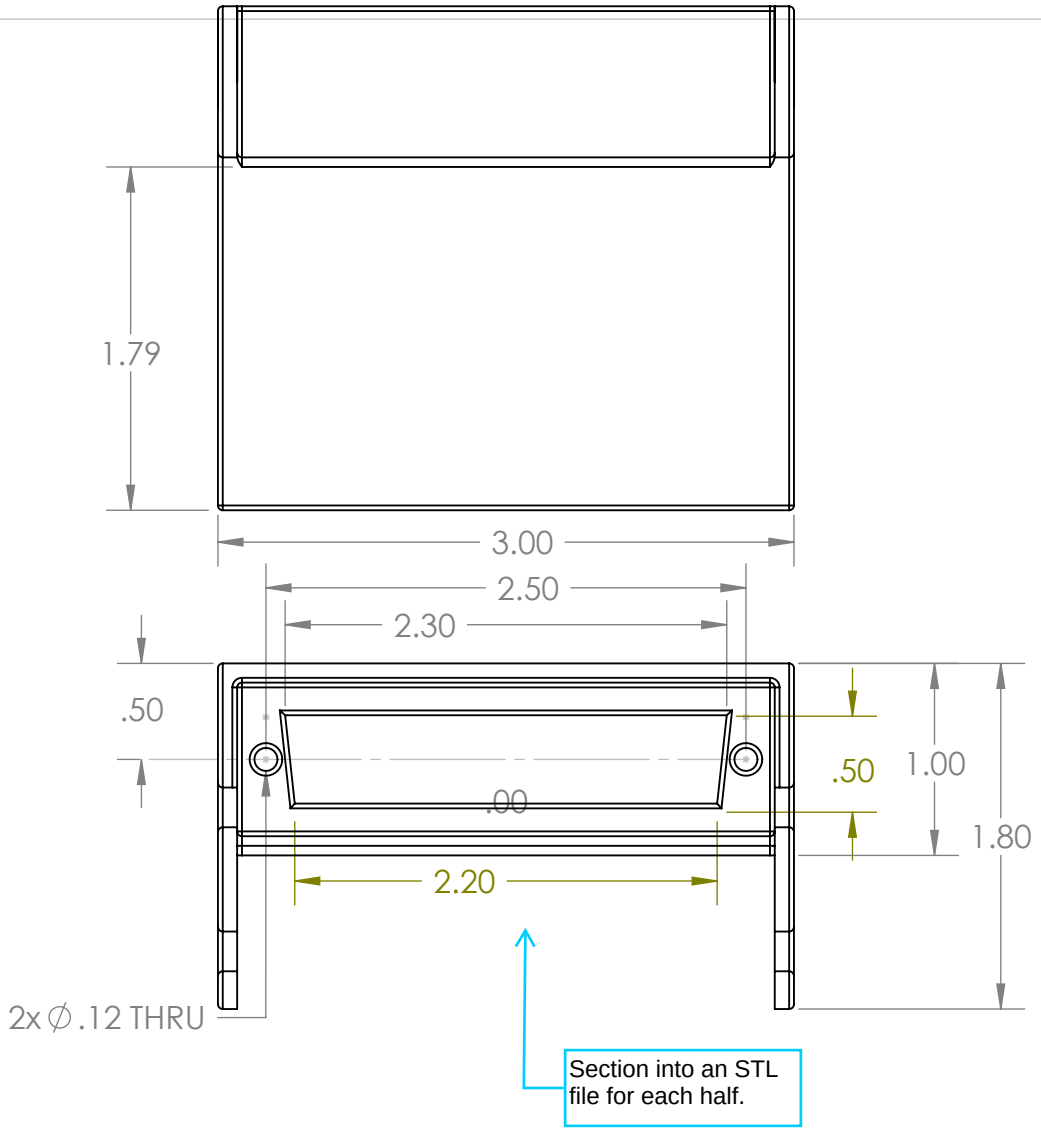

Section into an STL file for each half.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
37-pin D-sub Connector Mount

SIZE	DWG. NO.	REV
A.		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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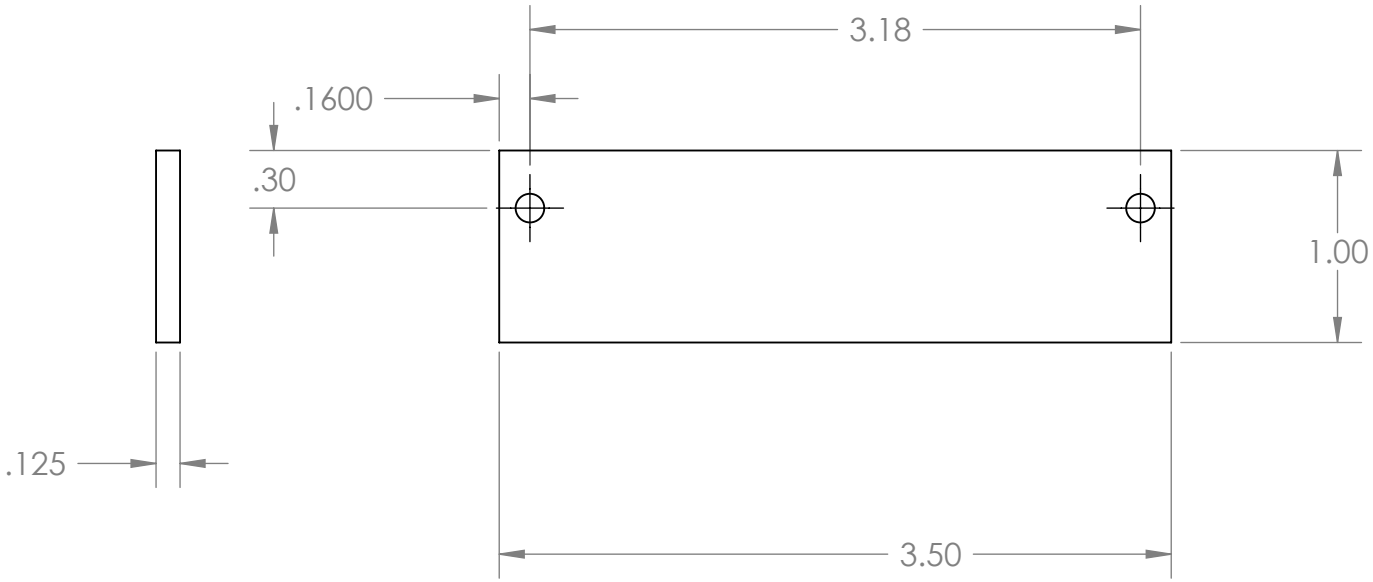

Print in PLA

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Electrical Cover

SIZE	DWG. NO.	REV
A	.	

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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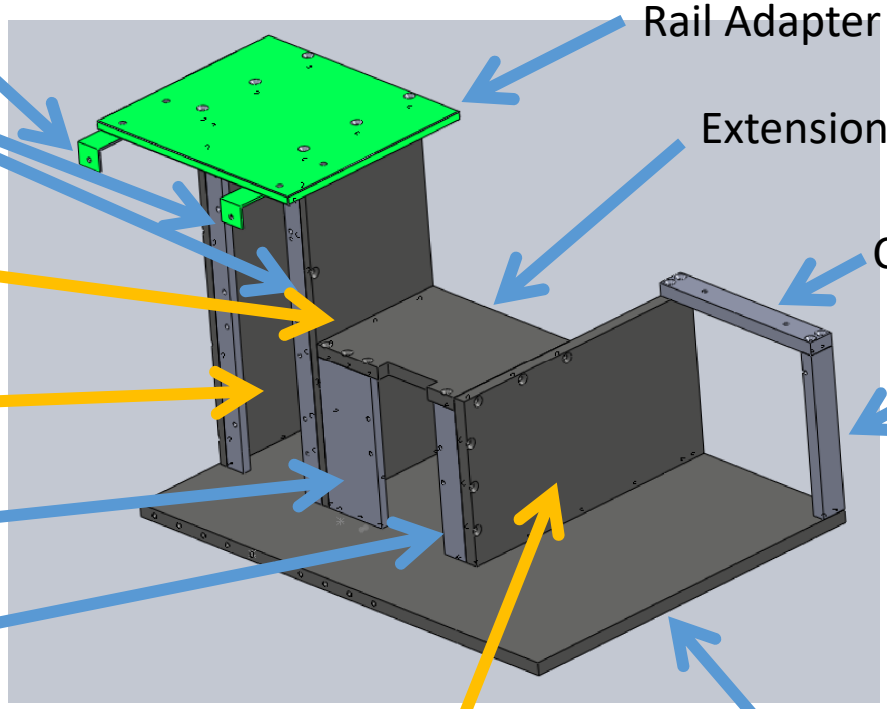
Overview of Motor Hanger Assembly



Assemble using 6-32 flathead screws. Do not over tighten

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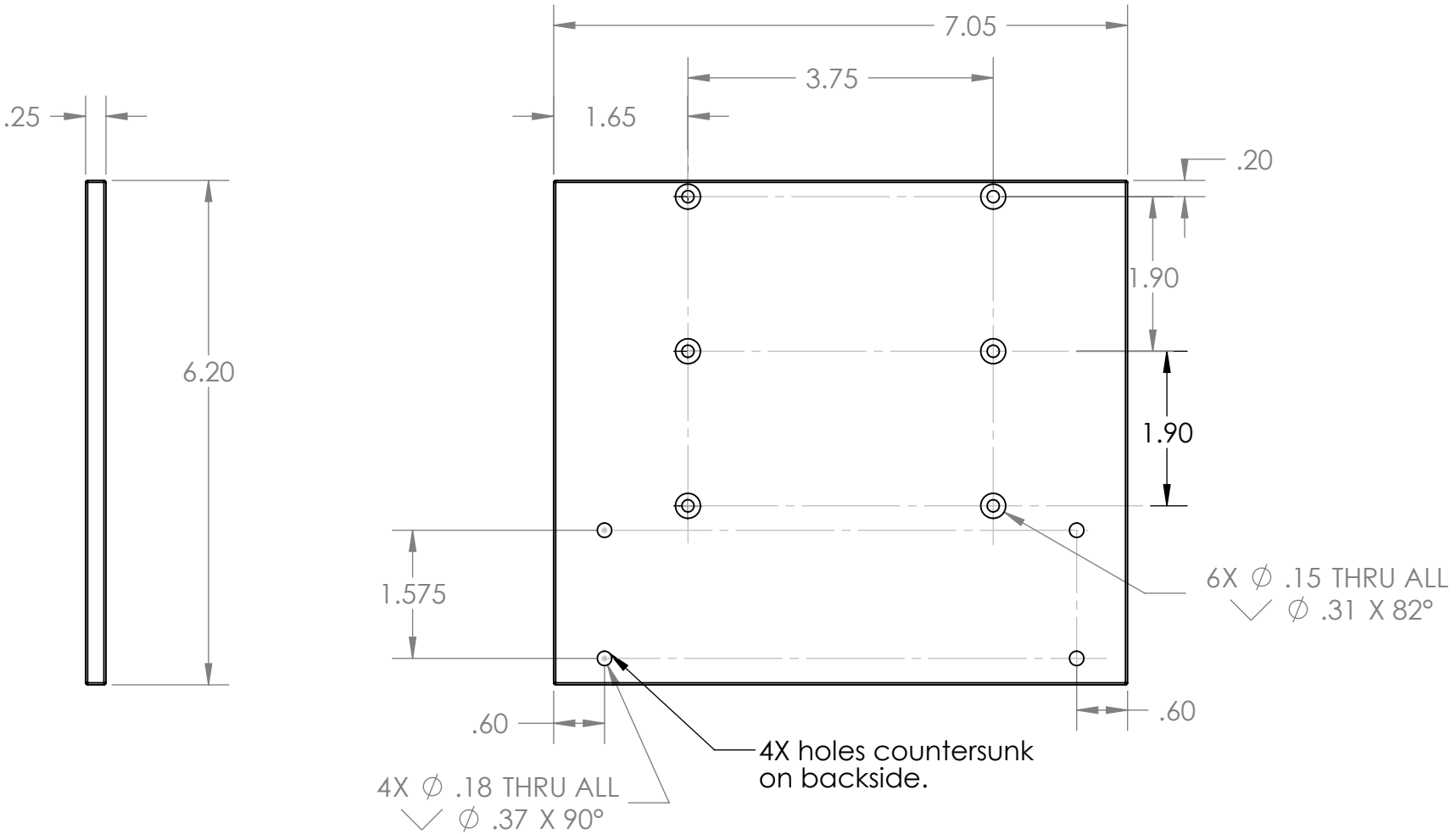

Material: Steel Plate

NOTE: Powder coat piece in chosen device color.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: Motor Assembly to Rail Adapter 5-11-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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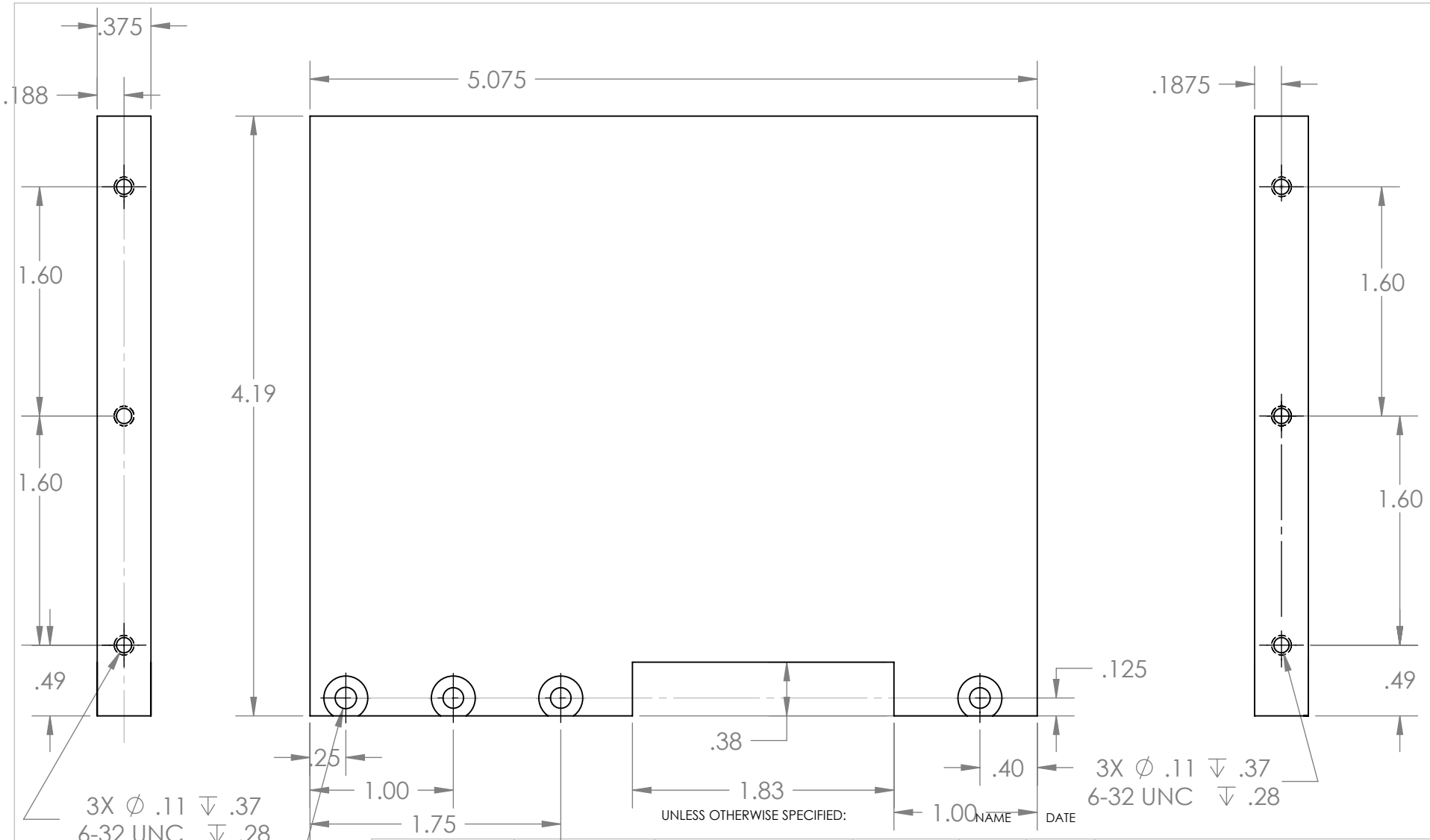

UNLESS OTHERWISE SPECIFIED:

NAME DATE

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION | DO NOT SCALE DRAWING

DRAWN
CHECKED
ENG APPR.
MFG APPR.
Q.A.
COMMENTS:

TITLE:

Extension Top Plate 10-29-2018

SIZE DWG. NO. REV

A

SCALE: 1:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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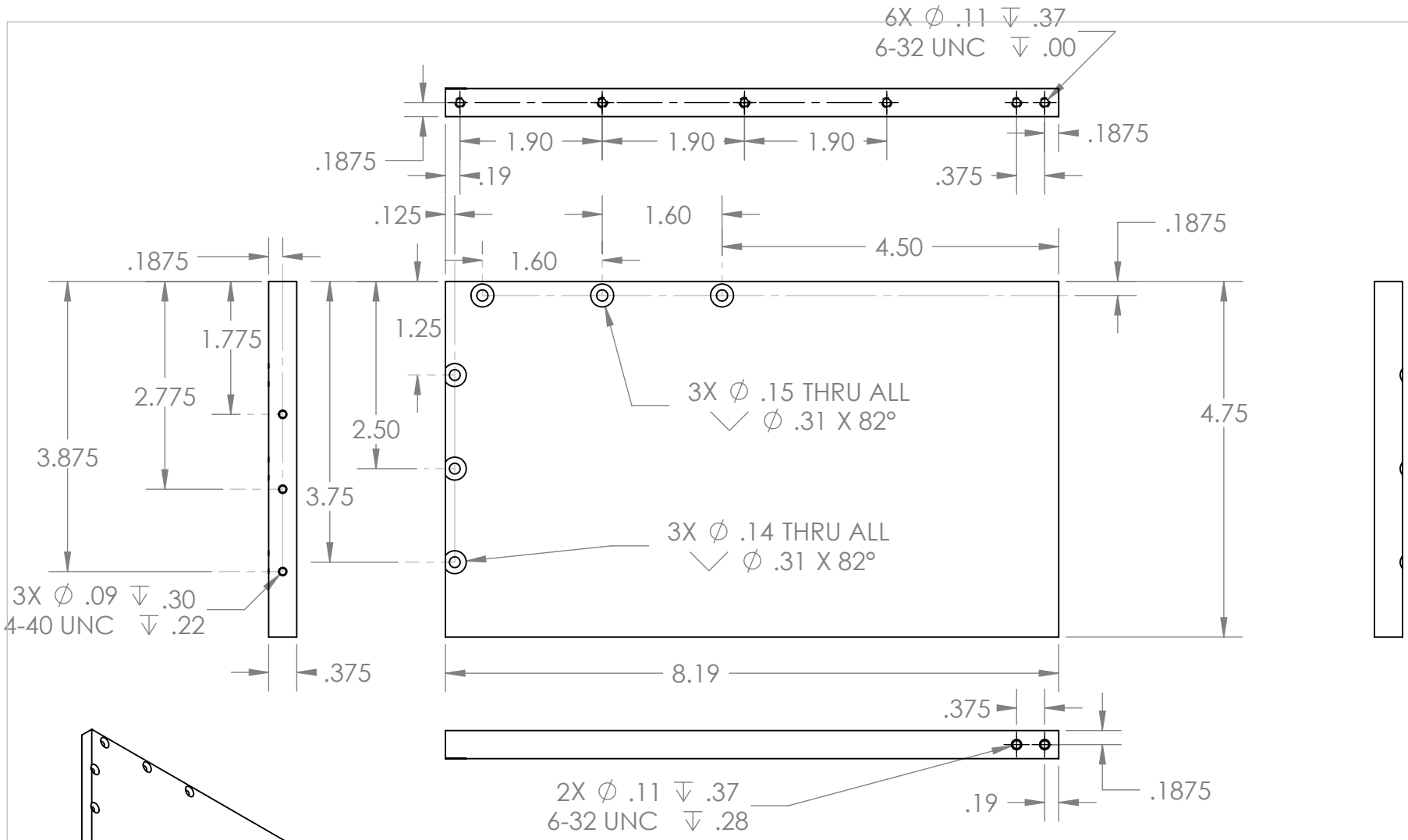
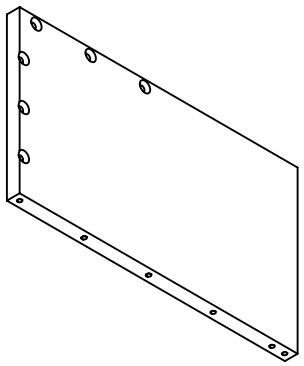




		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

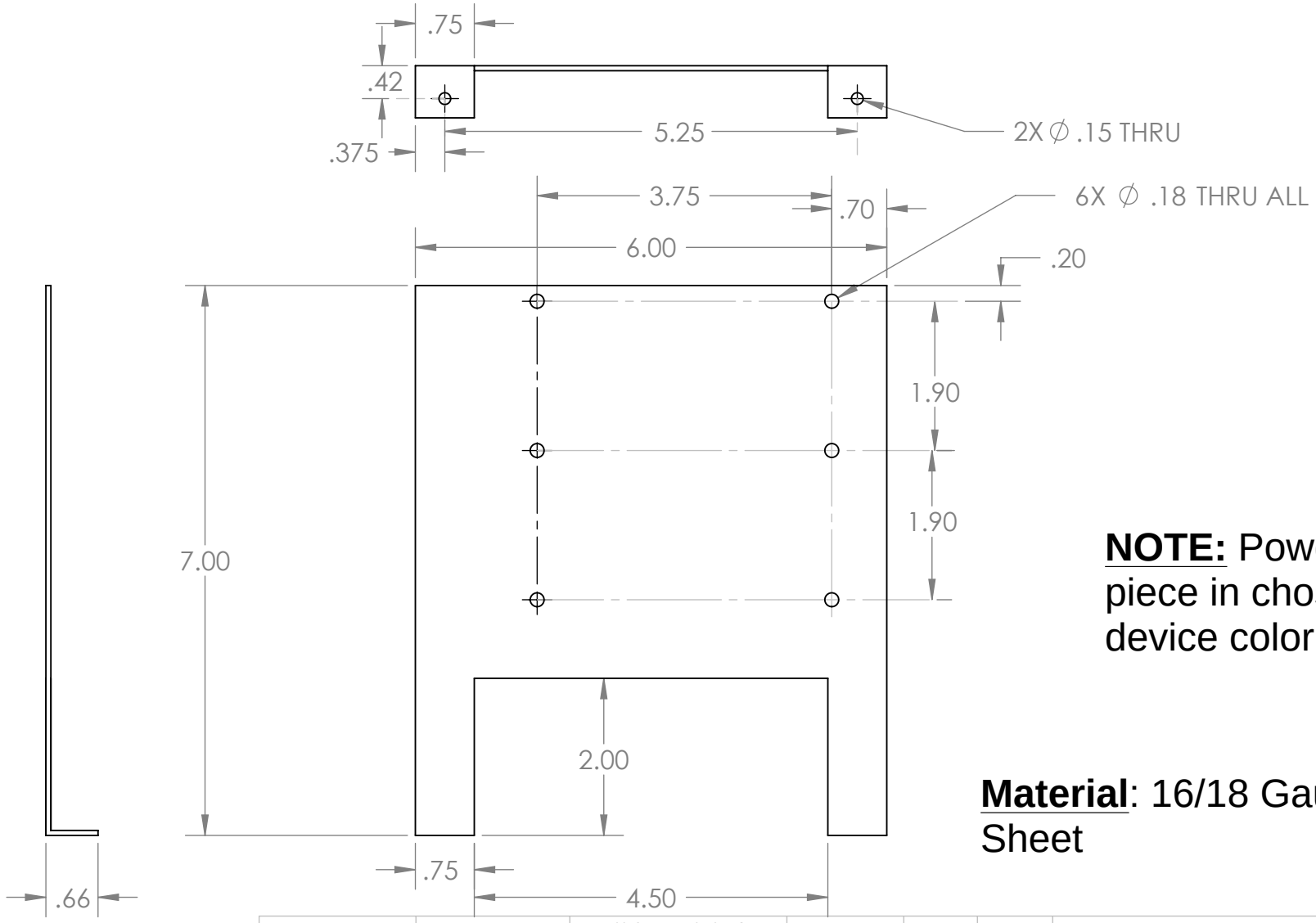
Motor Box Extension (JWH: 5-9-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



NOTE: Powder coat piece in chosen device color.

Material: 16/18 Gauge Steel Sheet

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

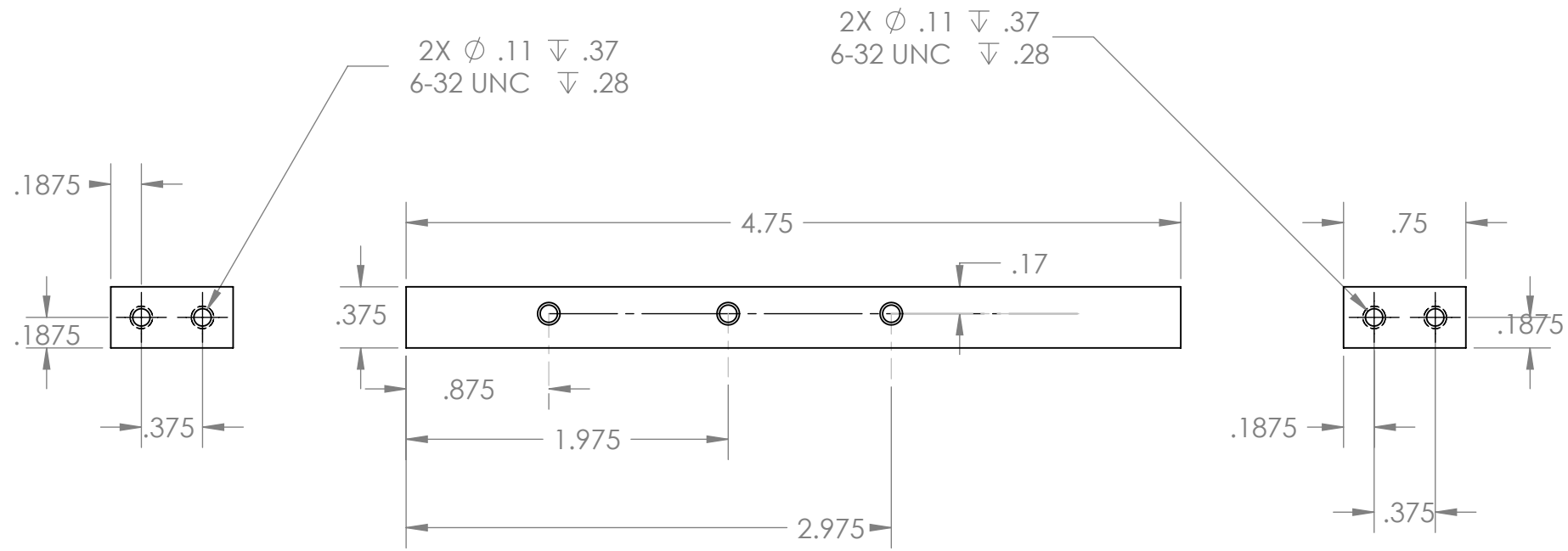
TITLE:
Top Mounting Plate
6-27-2016

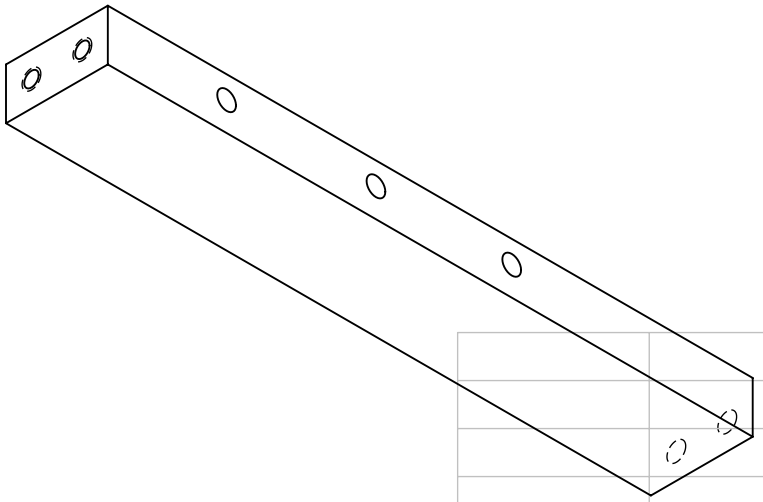
SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

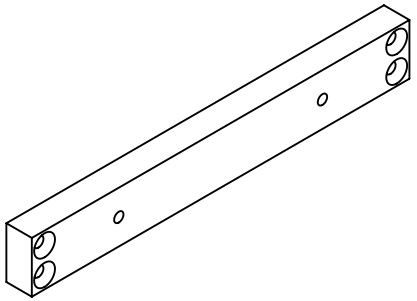
Cryoside Strut (JWH: 5-5-2016]

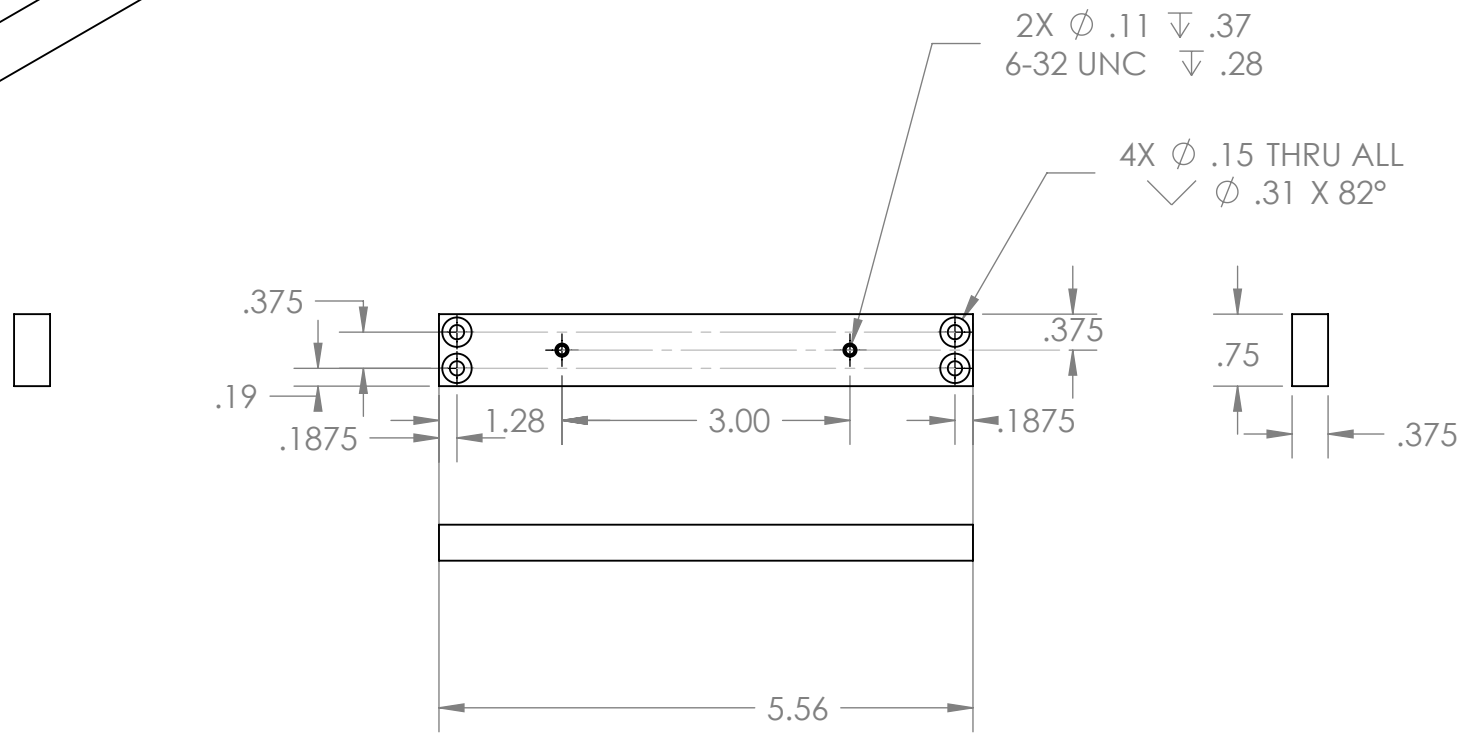
SIZE	DWG. NO.	REV
A	.	

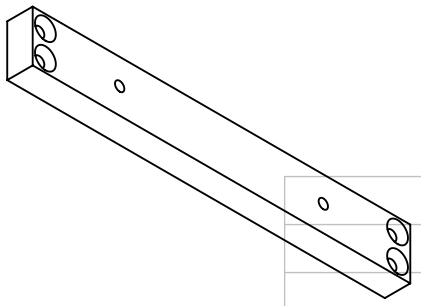
SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485







		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

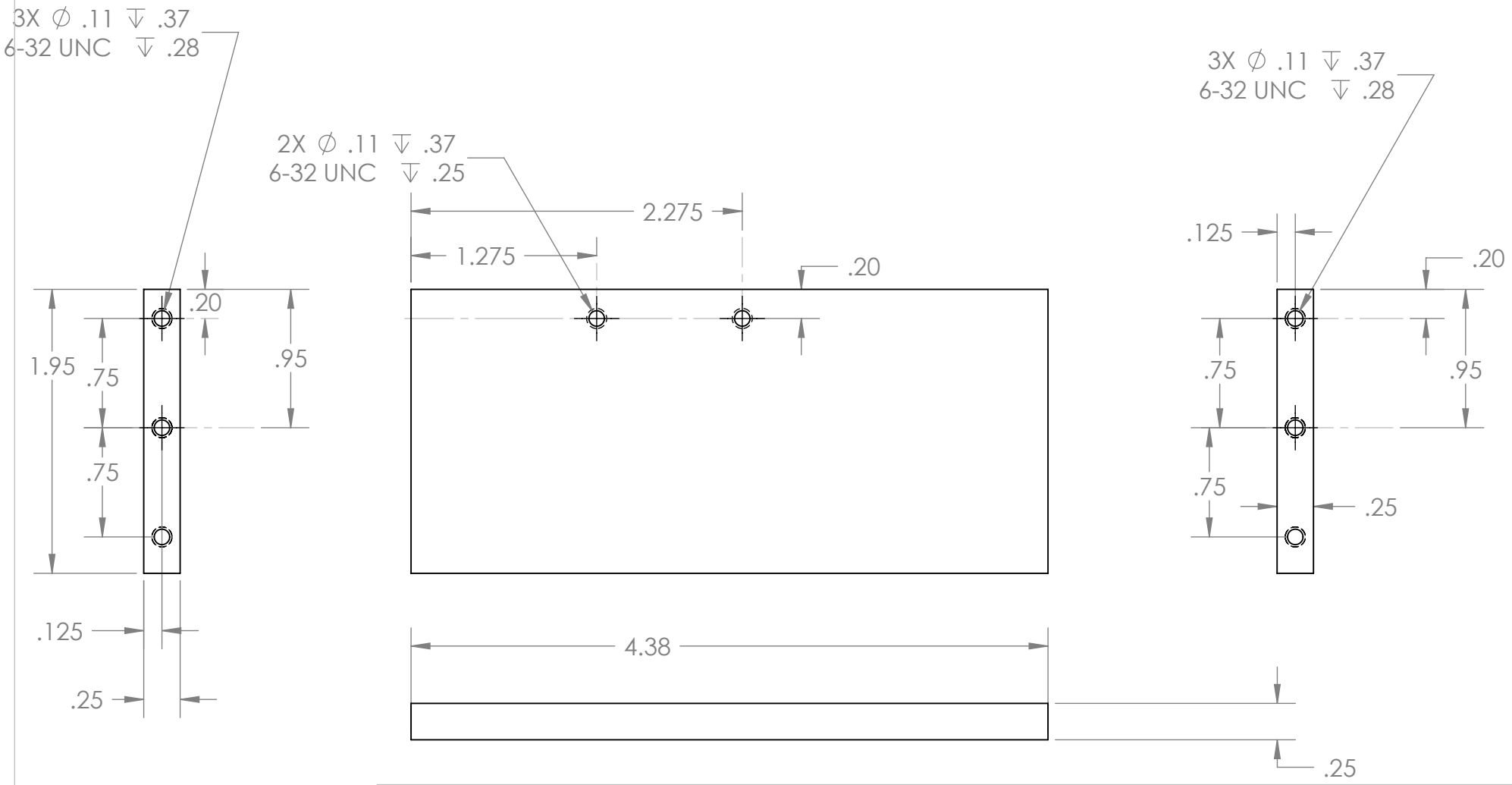
TITLE:
Cryotop Strut (JWH: 5-5-2016)

SIZE	DWG. NO.	REV
A	.	

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

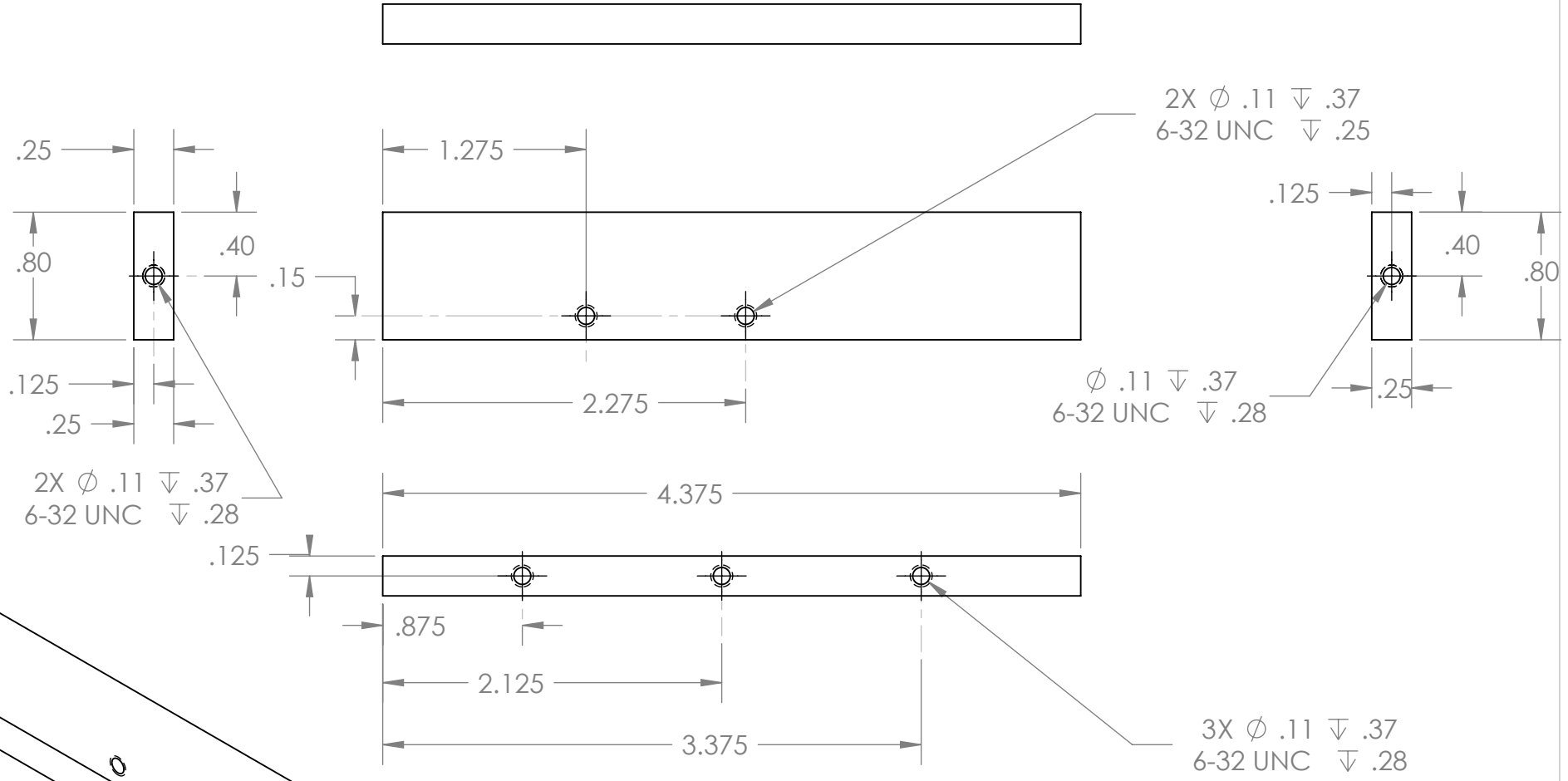
TITLE:
Right lock plate(-30C)
5-5-2016

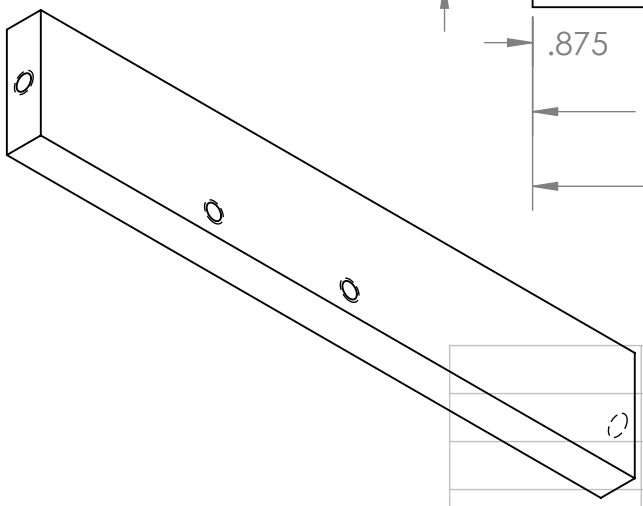
SIZE	DWG. NO.	REV
A		

SCALE: 1:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

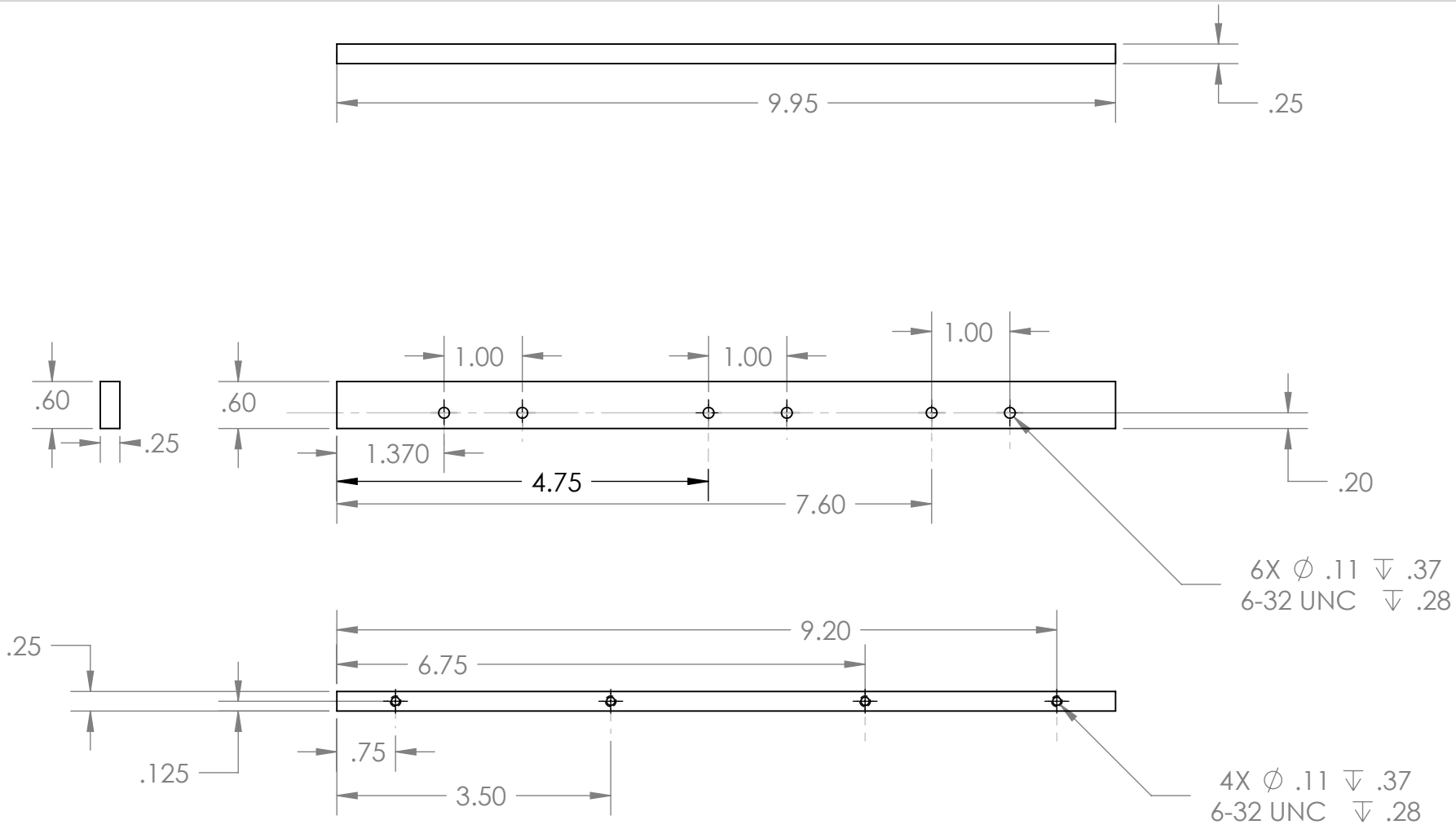
Left lock plate(-30C)
5-5-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
		MATERIAL			
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

QNTY:2

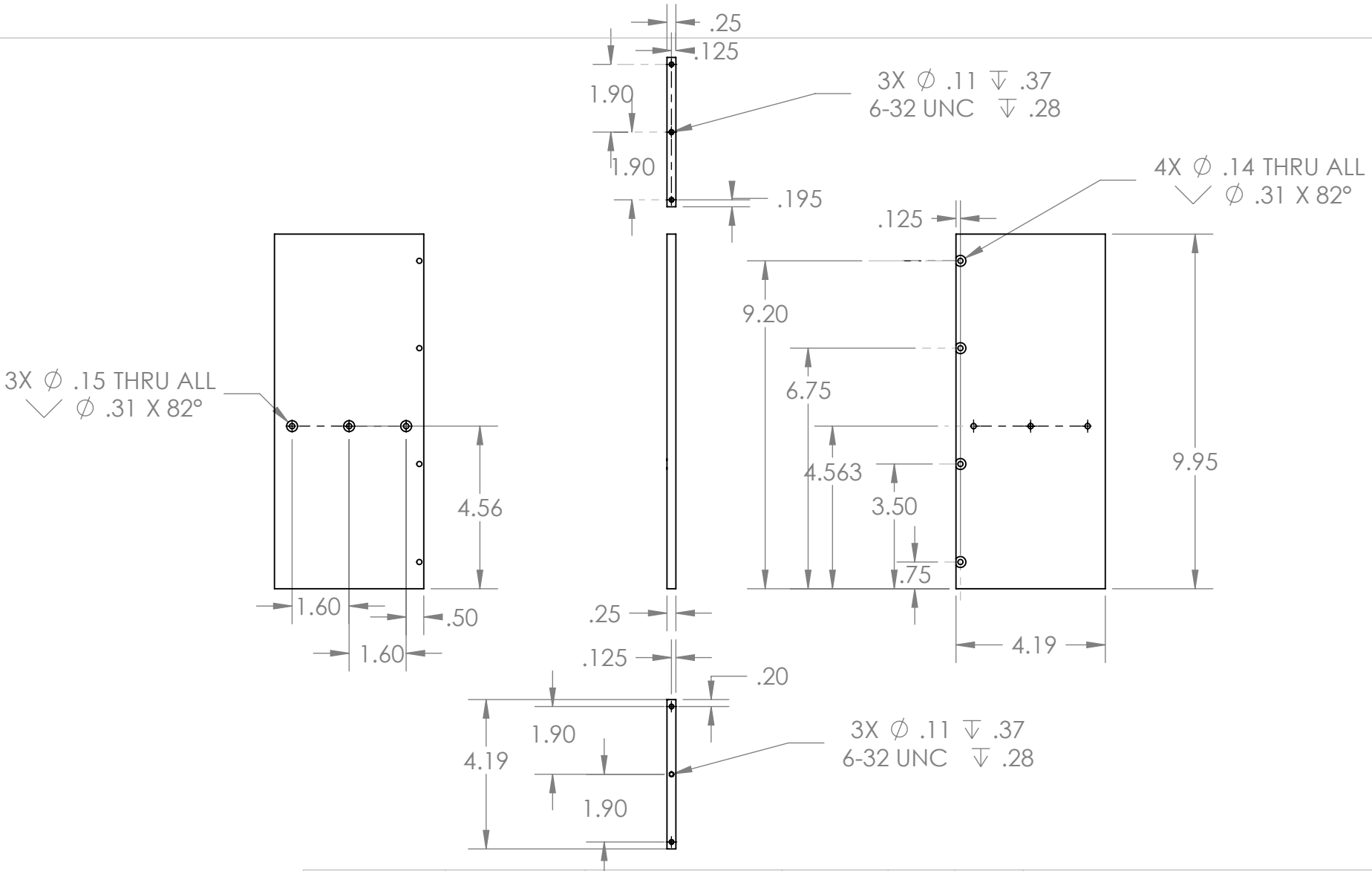
TITLE:
Right Lock Plate
4-24-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

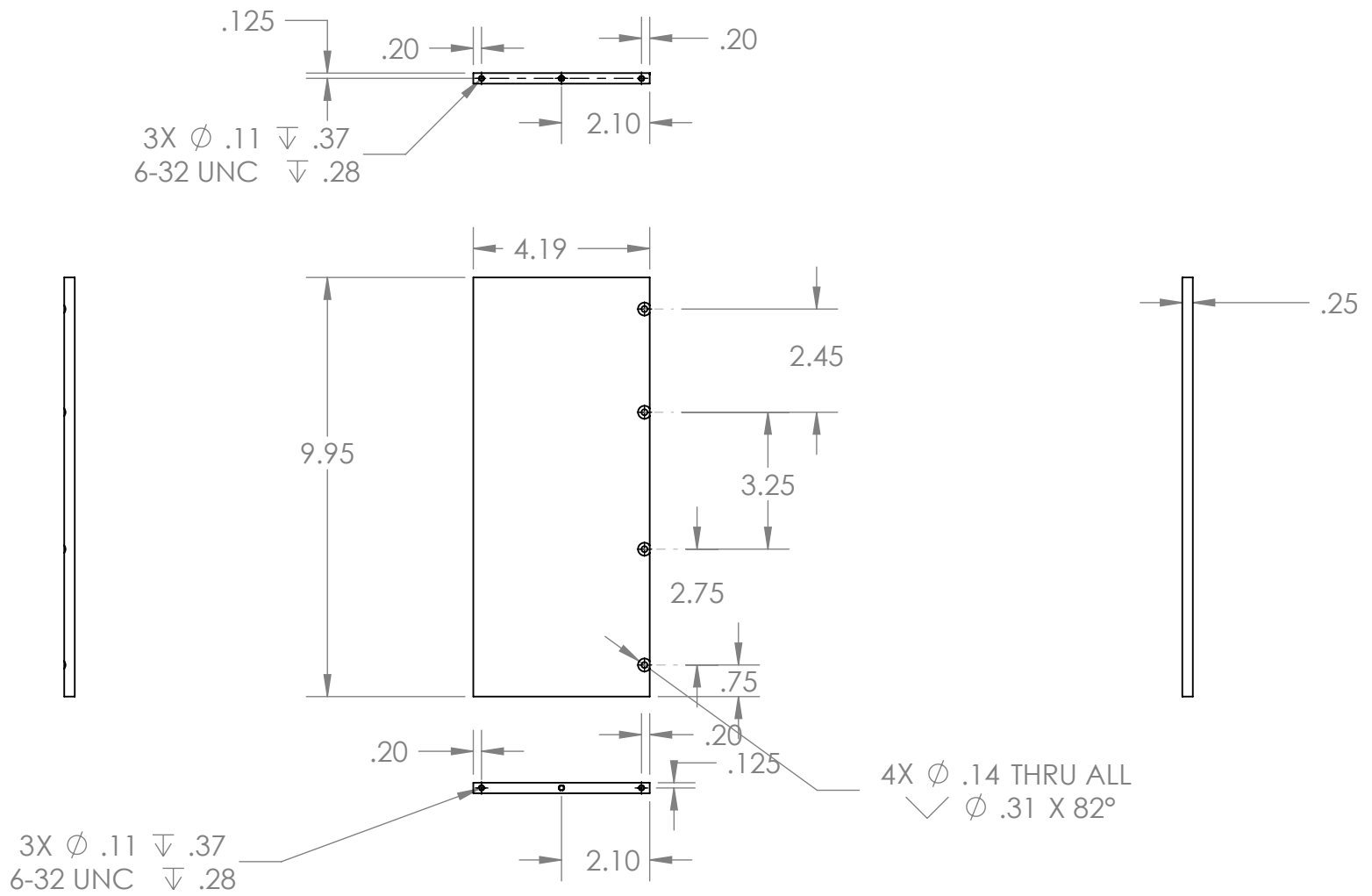
TITLE: Motor Box Side Panel (interior) 5-5-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

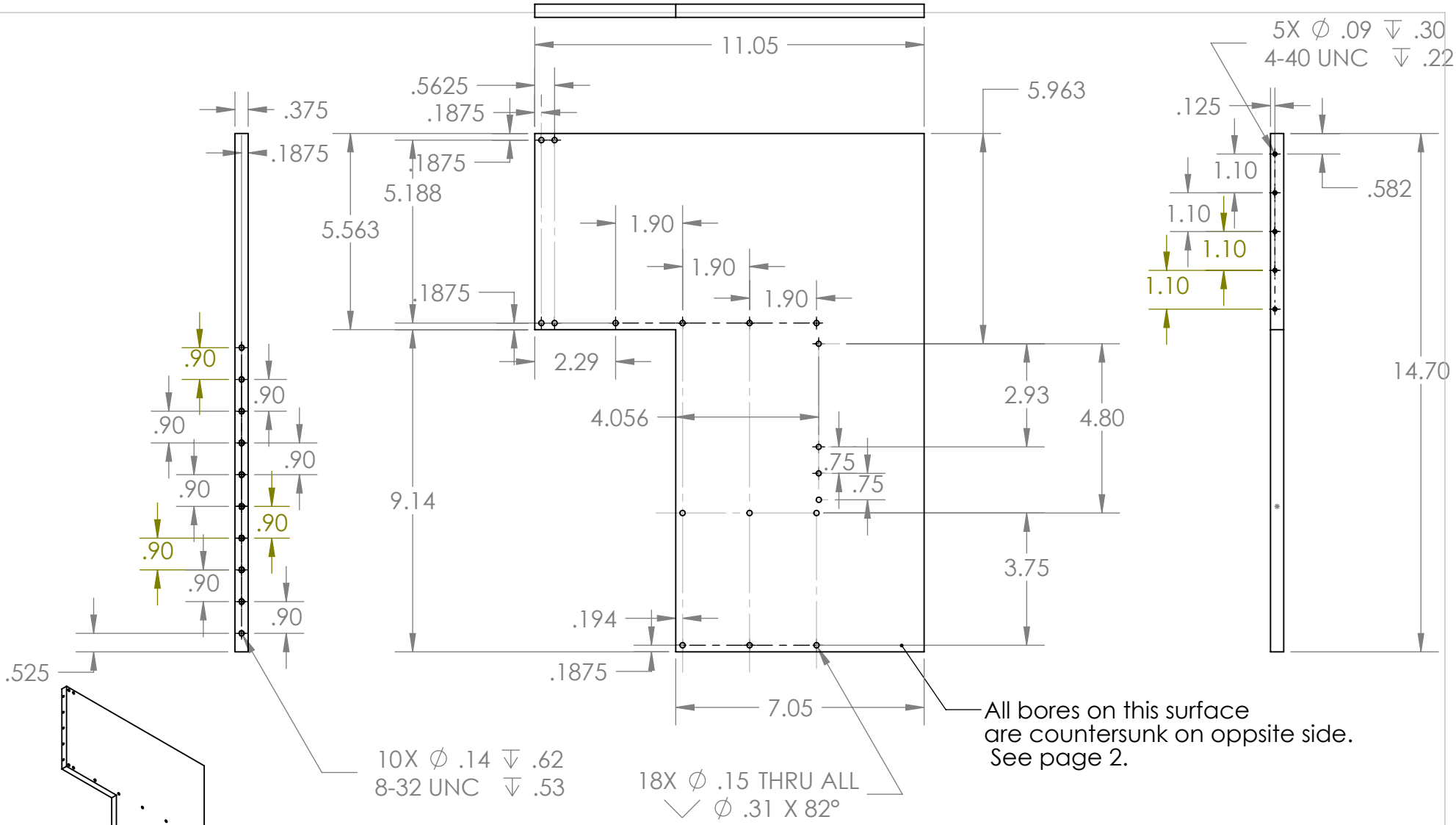
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE	
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN			TITLE: Motor box side panel (outside)
			CHECKED			
			ENG APPR.			
			MFG APPR.			
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
		MATERIAL	COMMENTS:			SIZE A / DWG. NO. / REV
NEXT ASSY	USED ON	FINISH				
APPLICATION		DO NOT SCALE DRAWING				SCALE: 1:4 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

PAGE 1

TITLE: Motor Rail Base (5-11-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

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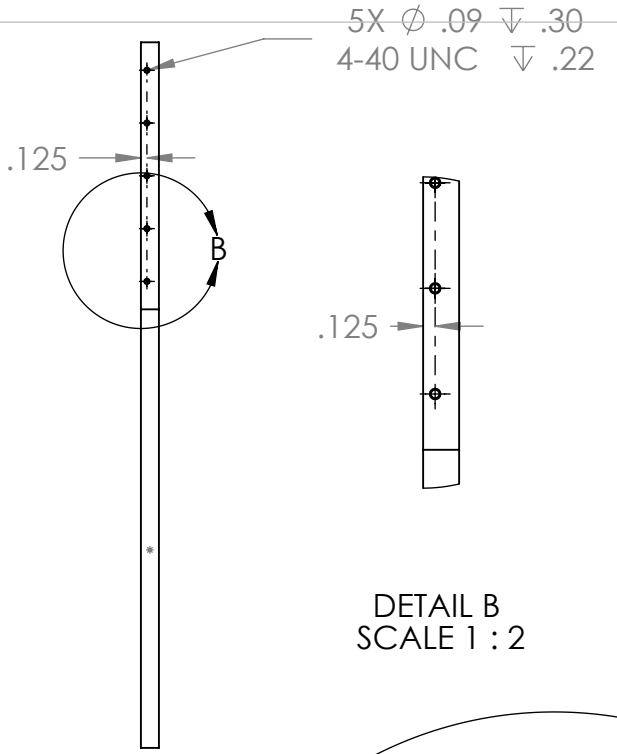
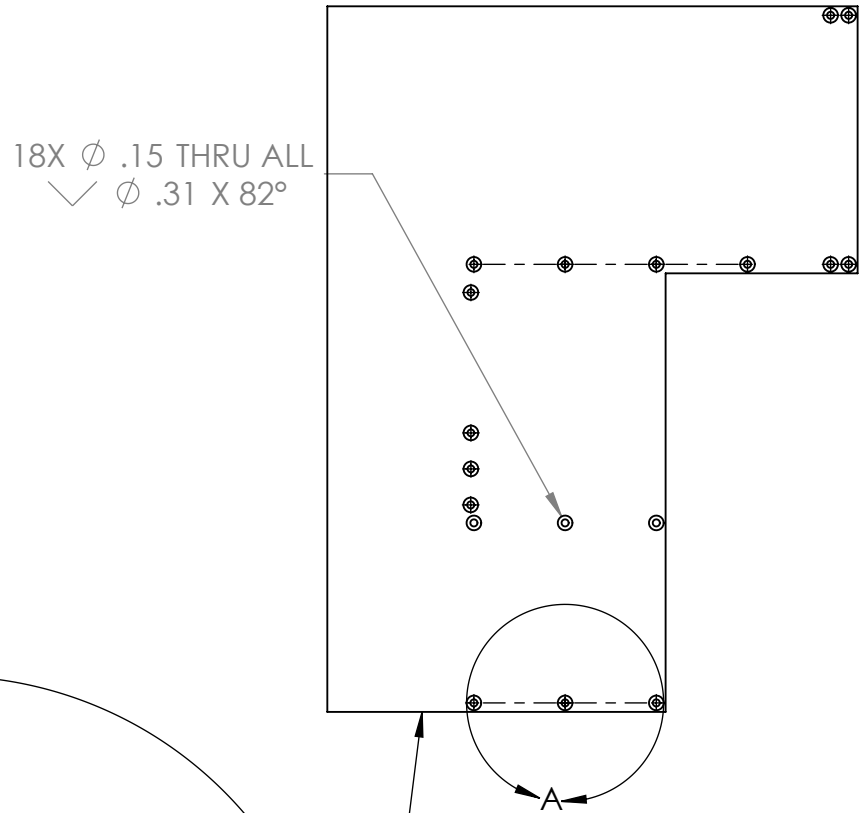
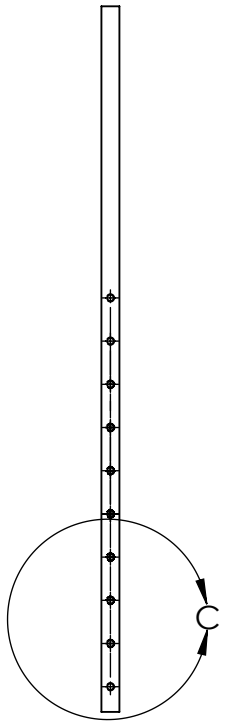
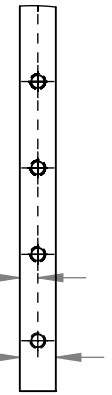


DETAIL B
SCALE 1 : 2

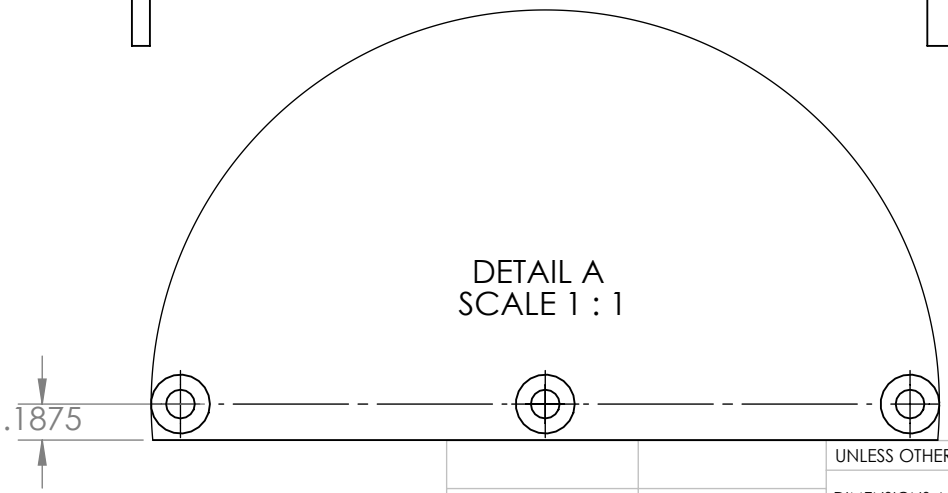


Countersink all holes on this surface.





DETAIL C
SCALE 1 : 2



DETAIL A
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Page 2.

TITLE: Motor Rail Base (5-11-2016)

SIZE	DWG. NO.	REV
A		

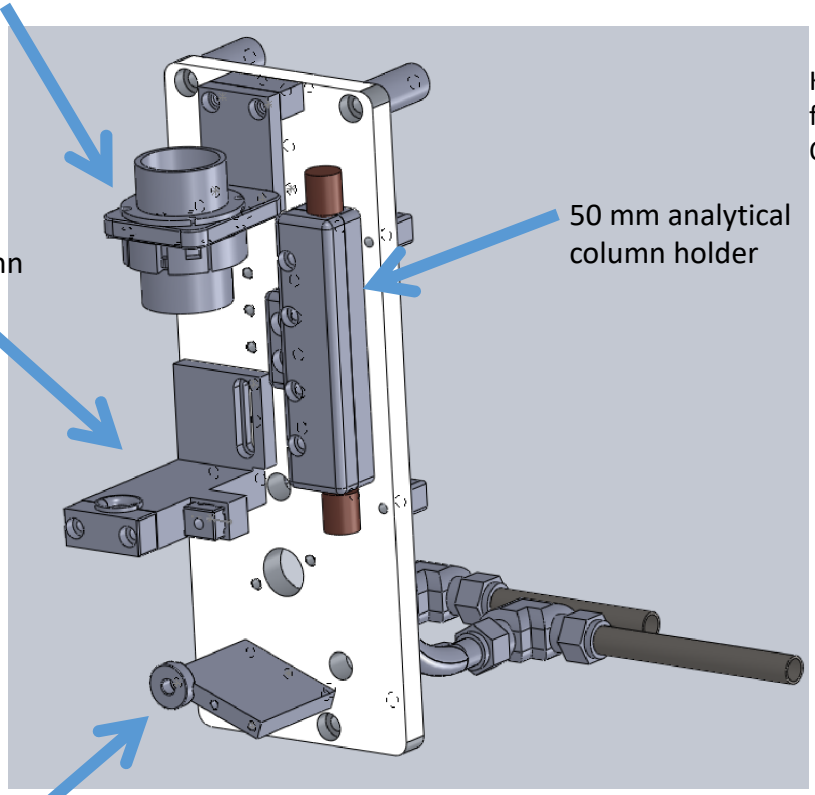
SCALE: 1:4 WEIGHT: SHEET 2 OF 2

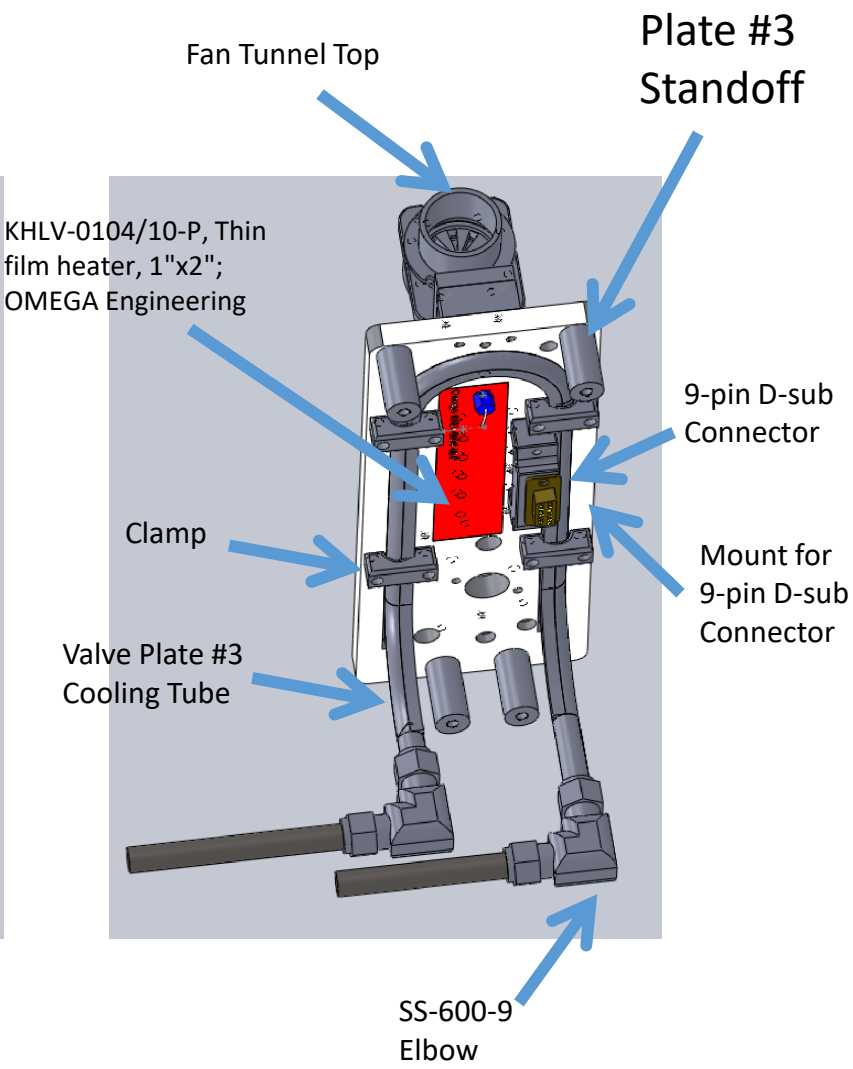
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

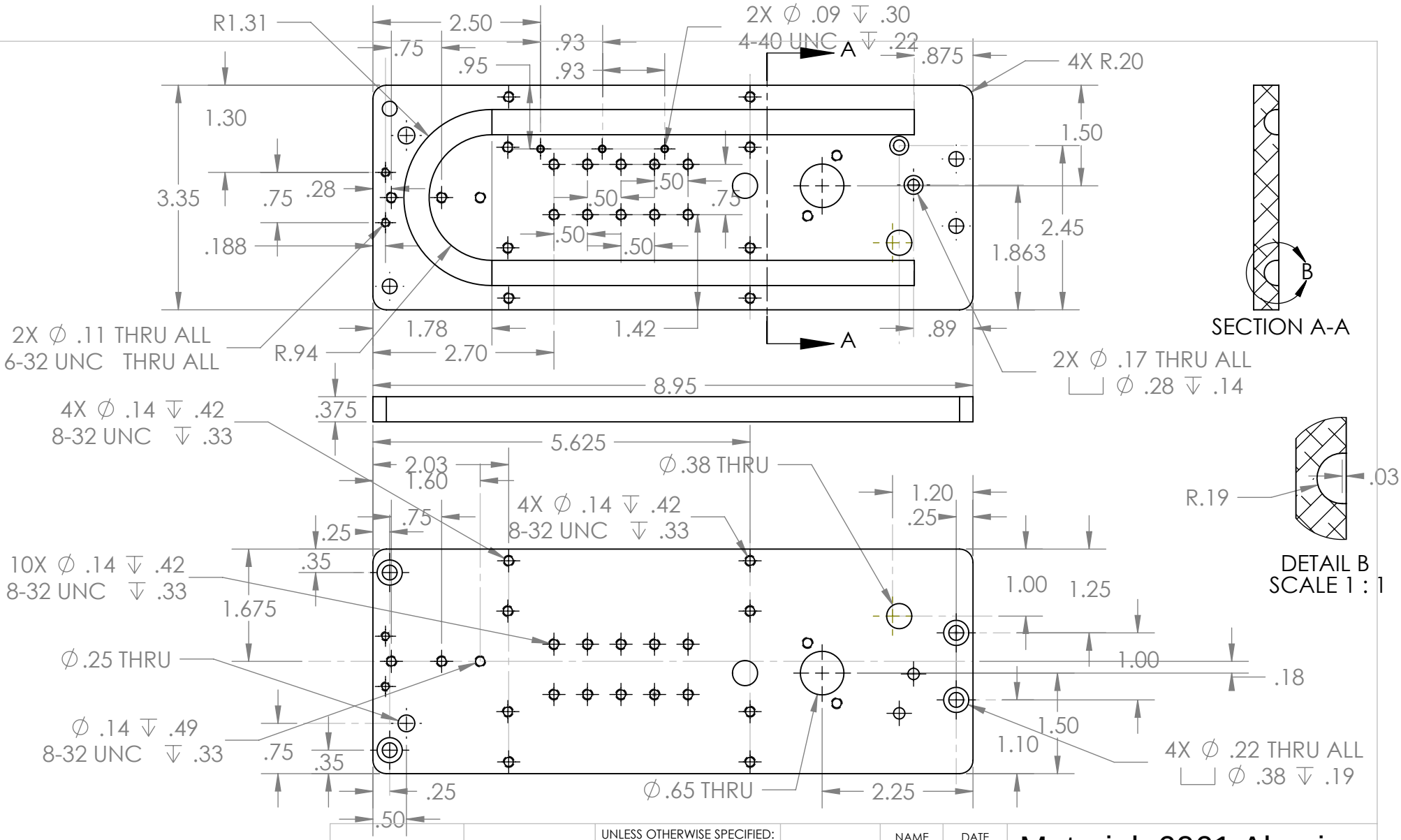
Valve #3 Plate Assembly

Fan Tunnel Assembly (6 parts)
Note: 1.6 CFM Fan is mounted on bottom of *"Fan Riser (-30C)"* using 2-56 screws.





Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 Aluminum

TITLE:

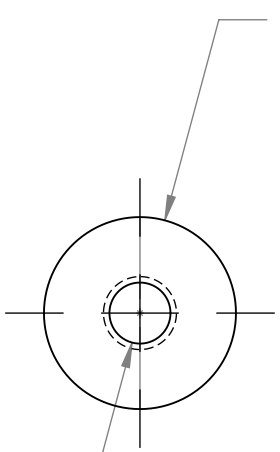
Valve #3 Plate (JWH: 5-5-2016)

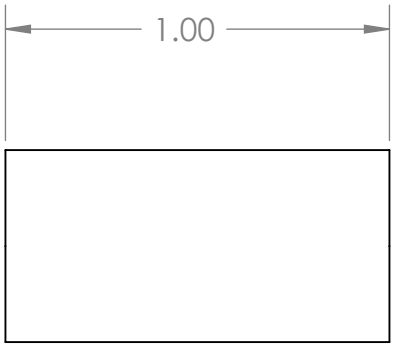
SIZE	DWG. NO.	REV
A	.	

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





Material: Delrin or equivalent

Quantity: 4

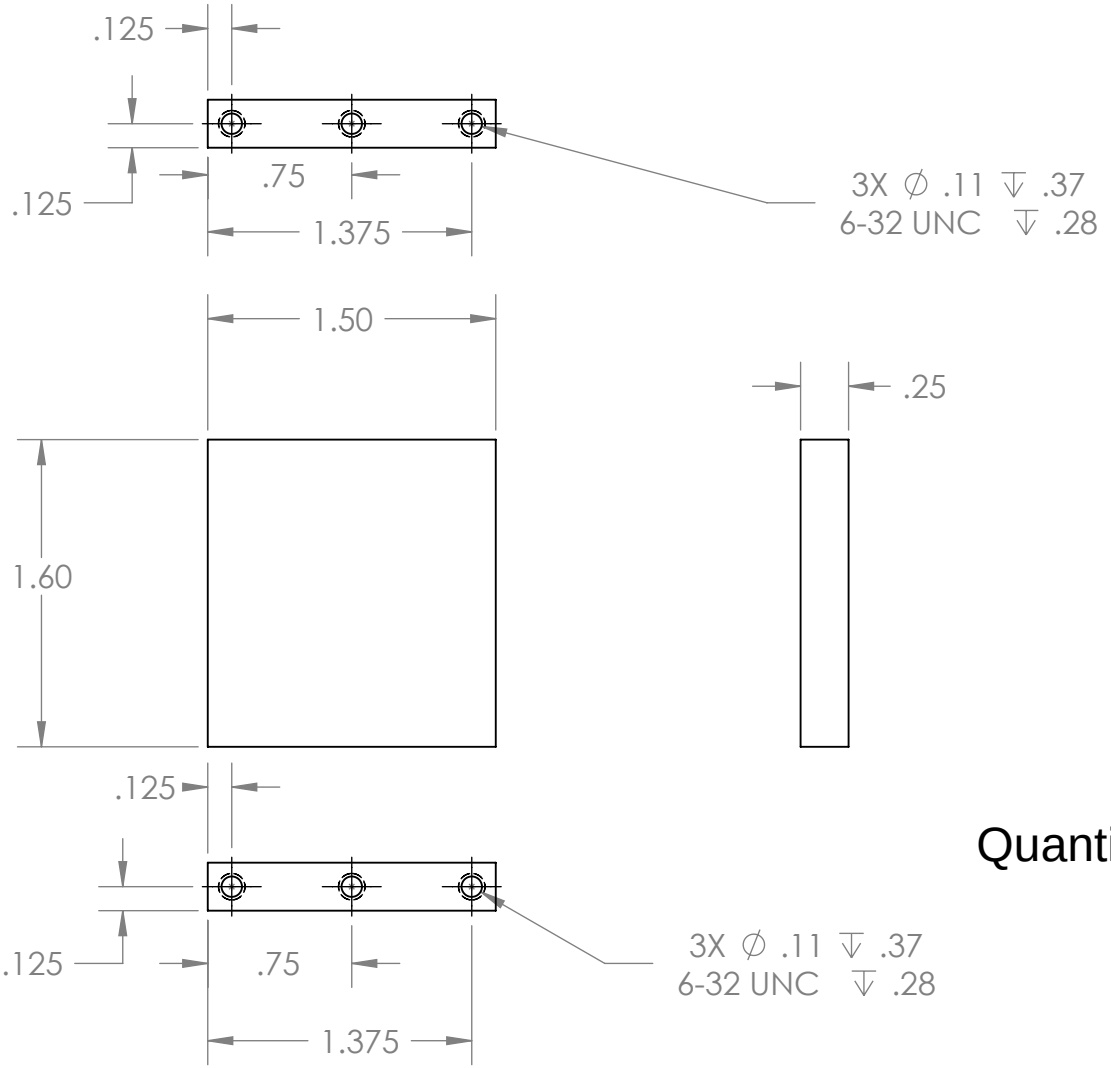
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Standoff valve plate #3
(JWH: 5-5-2016)

SIZE	DWG. NO.	REV
A	Plate #3 standoff	
SCALE: 2:1	WEIGHT:	SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Quantity: 3

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 Aluminum

TITLE:
Capillary Clamp Riser
(JWH: 4-1-2016)

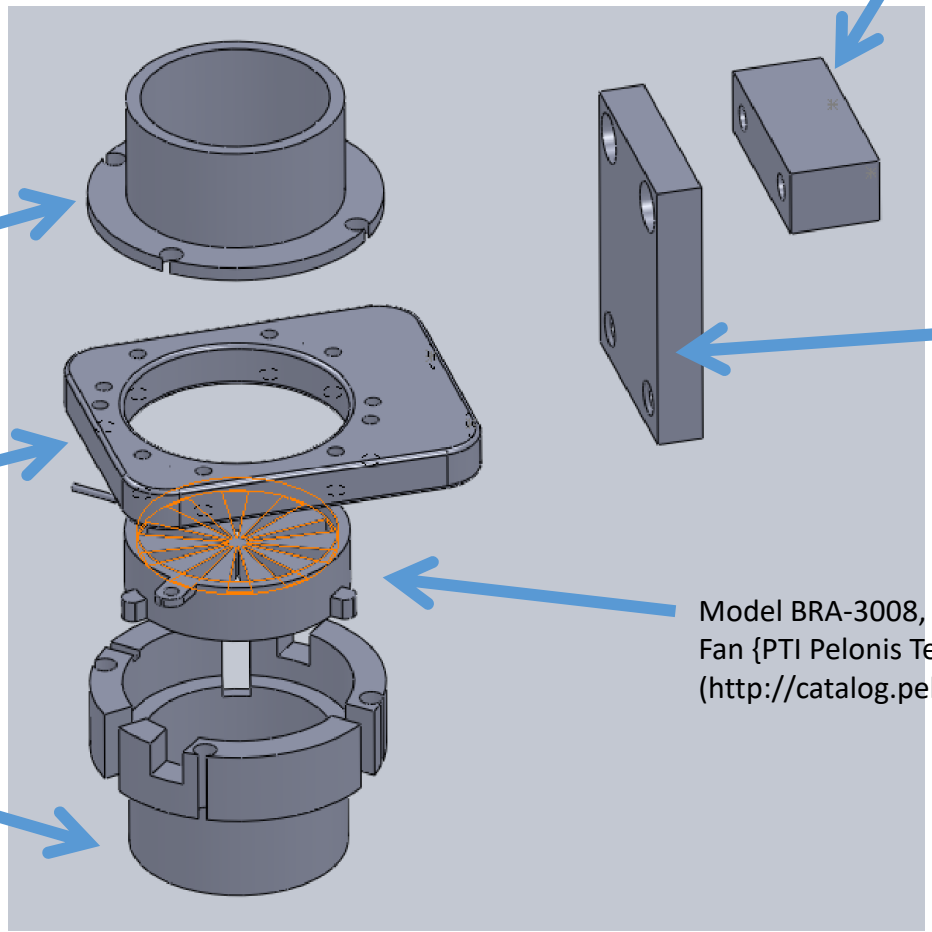
SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

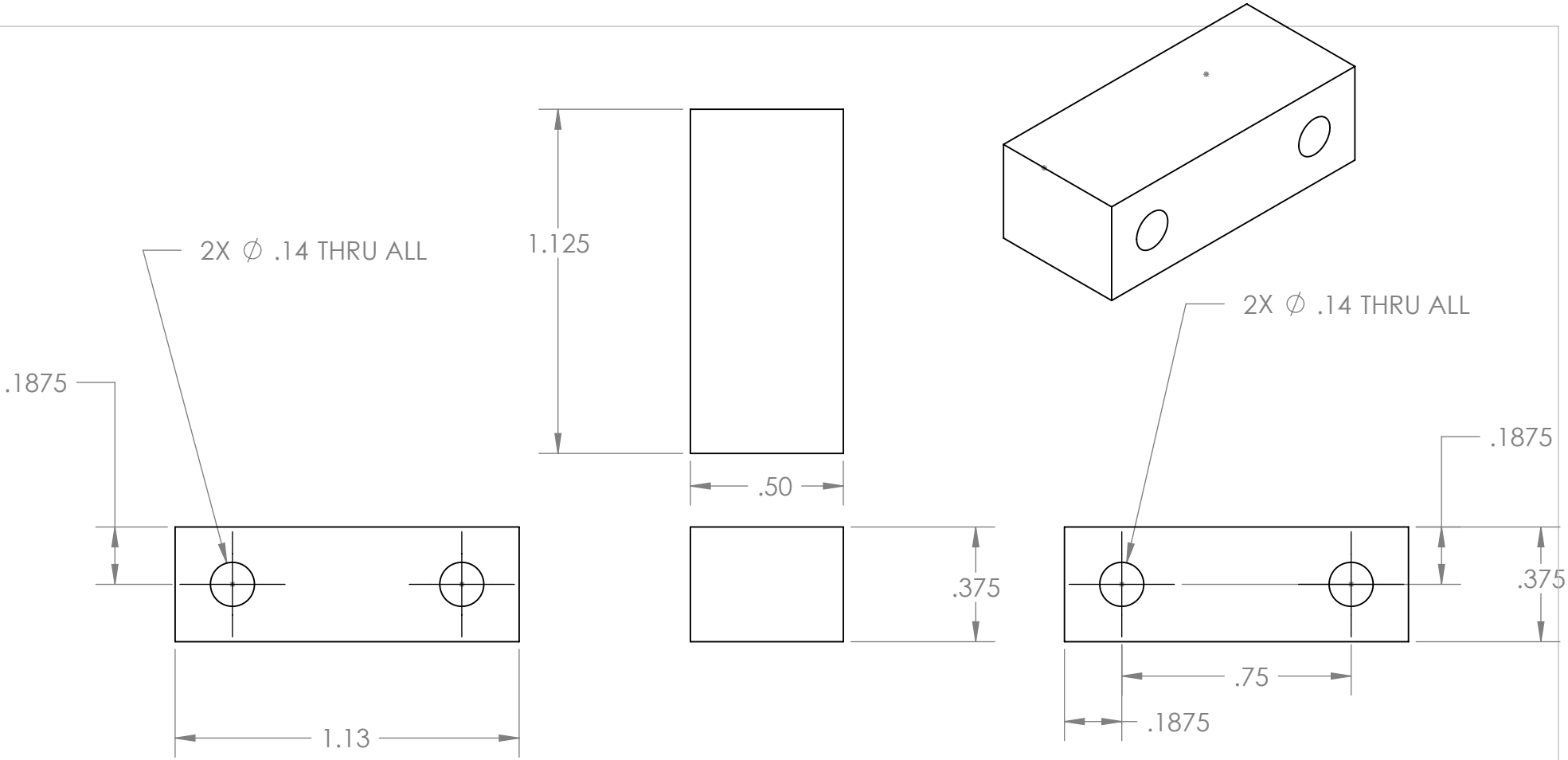
5 4 3 2 1

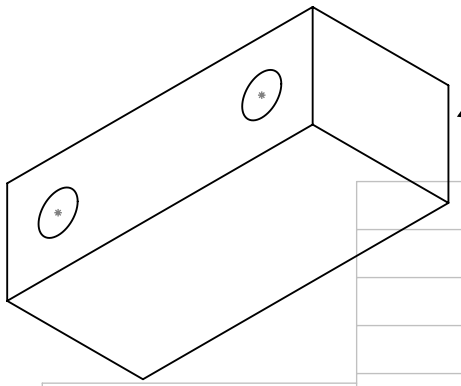
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Plate #3 Fan Assembly



Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





Black Anodize all surfaces

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:

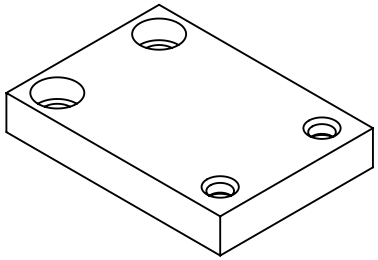
Fan riser (part 1) (JWH: 4-9-2016)

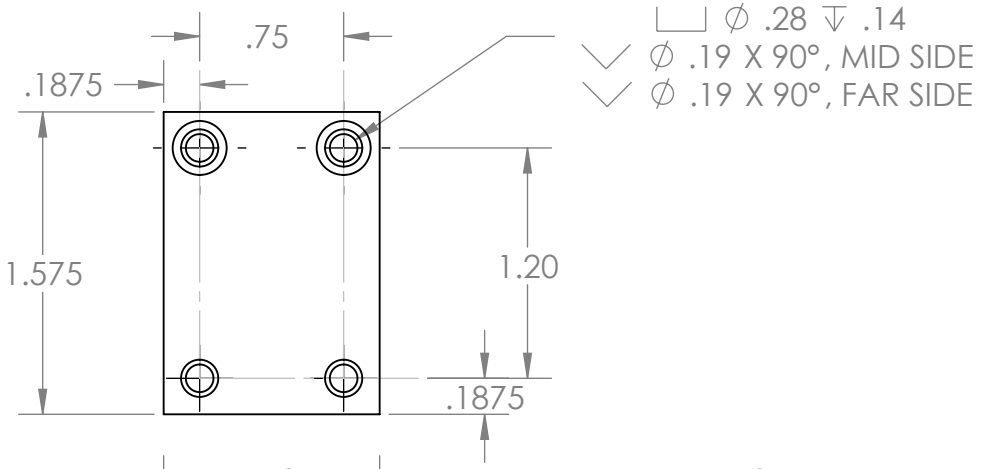
SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 1 OF 1

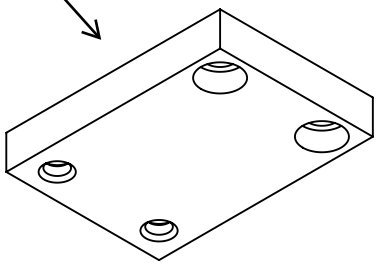
5 4 3 2 1

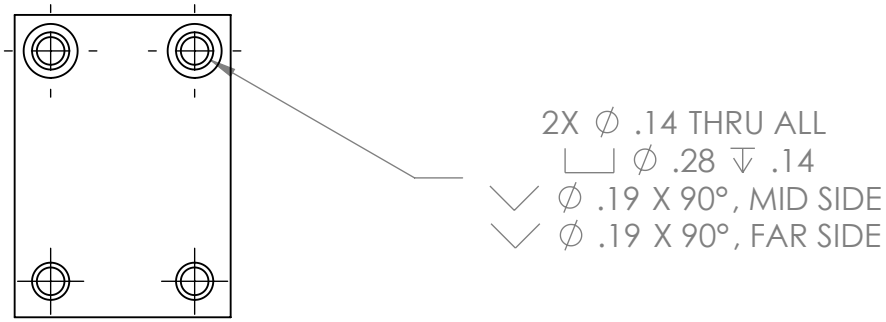
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





Black Anodize all surfaces





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:

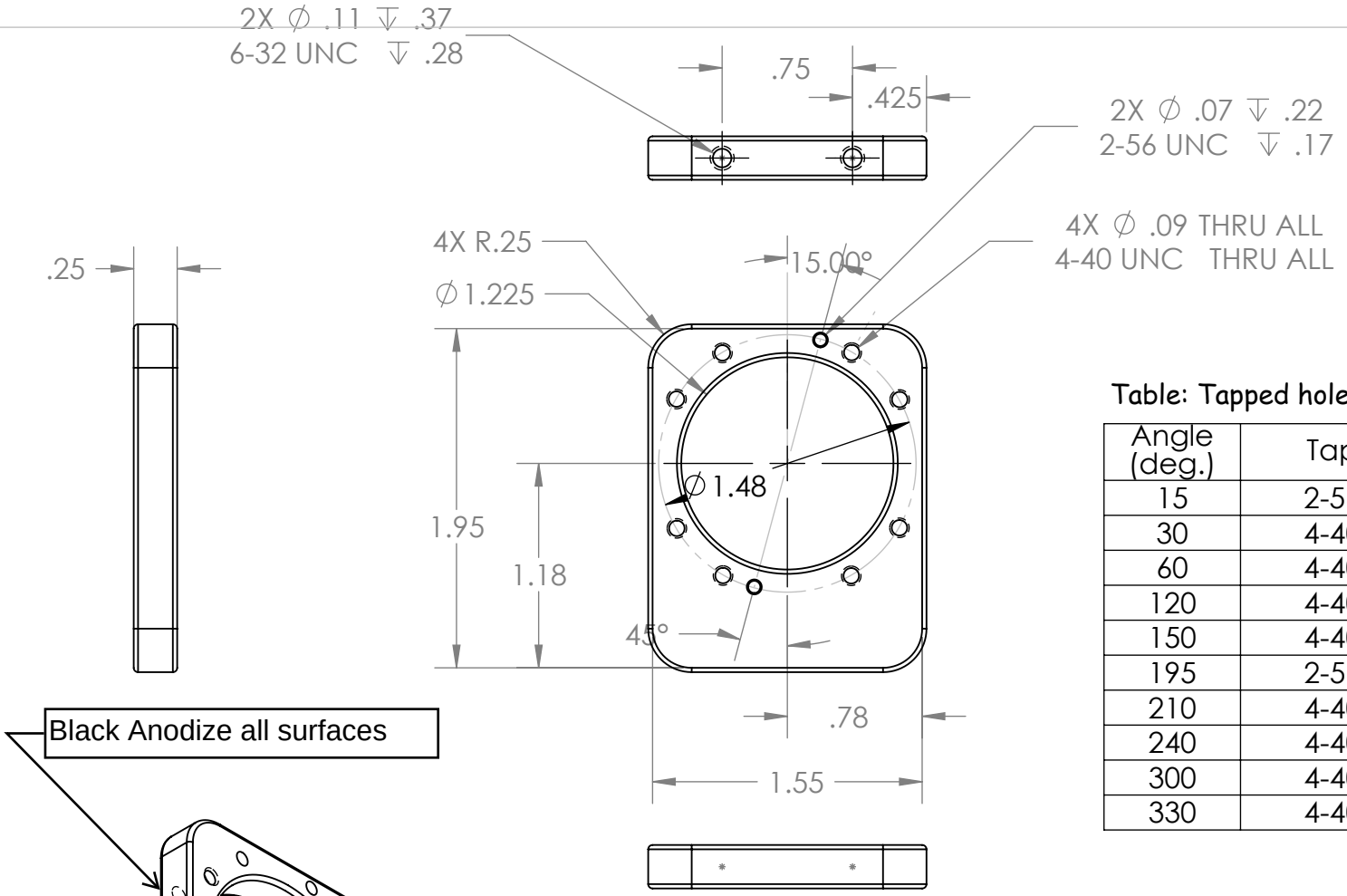
Fan riser (part 2)

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Black Anodize all surfaces

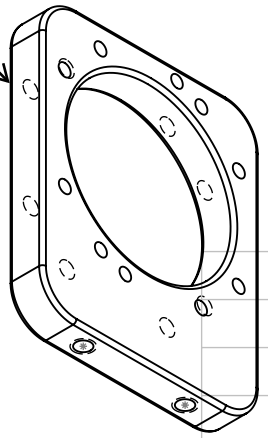


Table: Tapped holes on 1.48" B.C.

Angle (deg.)	Tap	Depth
15	2-56	0.2"
30	4-40	thru
60	4-40	thru
120	4-40	thru
150	4-40	thru
195	2-56	0.2"
210	4-40	thru
240	4-40	thru
300	4-40	thru
330	4-40	thru

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

Material: 6061 AL

TITLE:

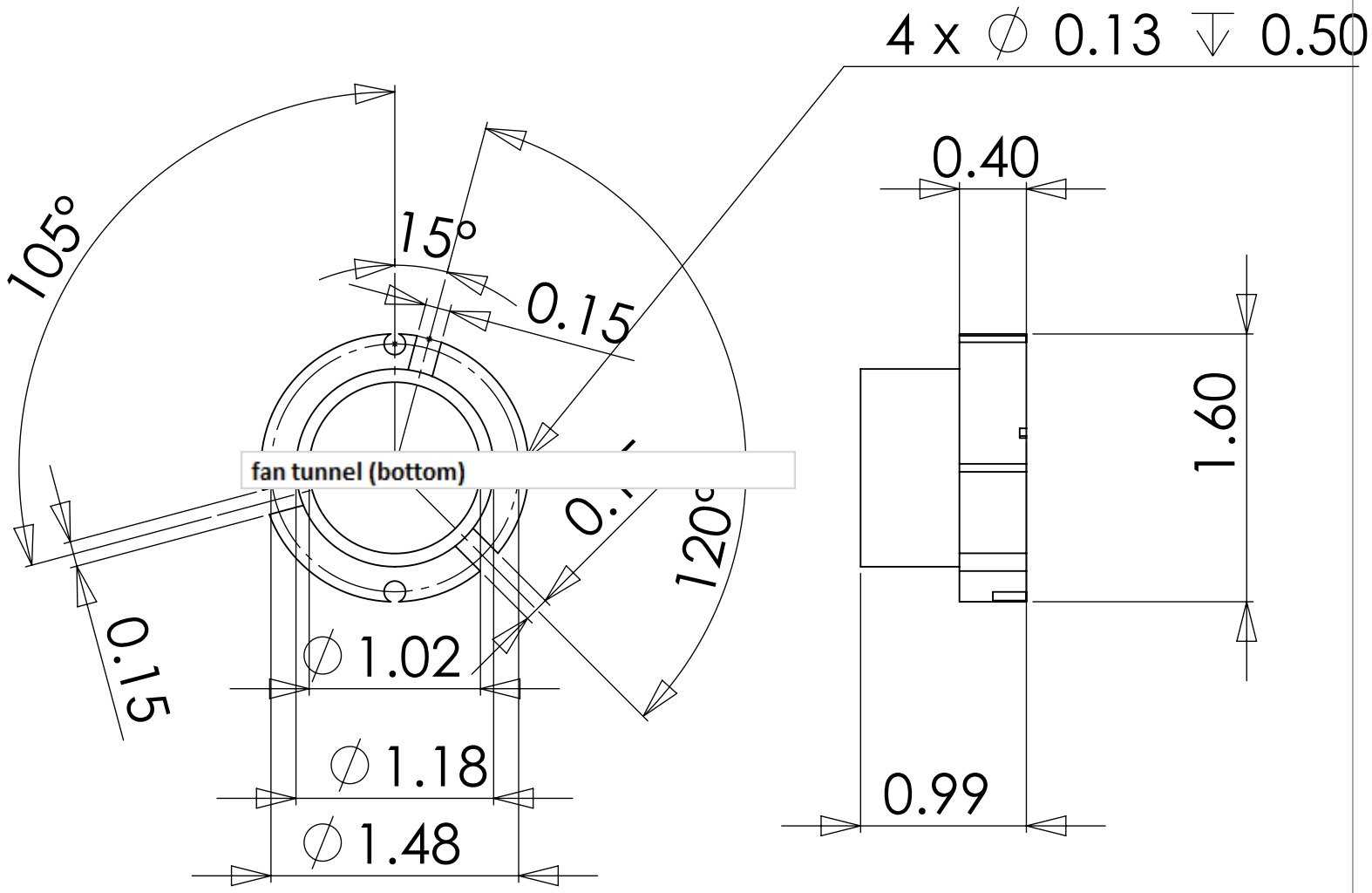
Fan riser (part 3) (JWH: 4-9-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



fan tunnel (bottom)

3D Print in PLA

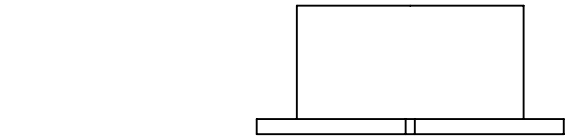
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

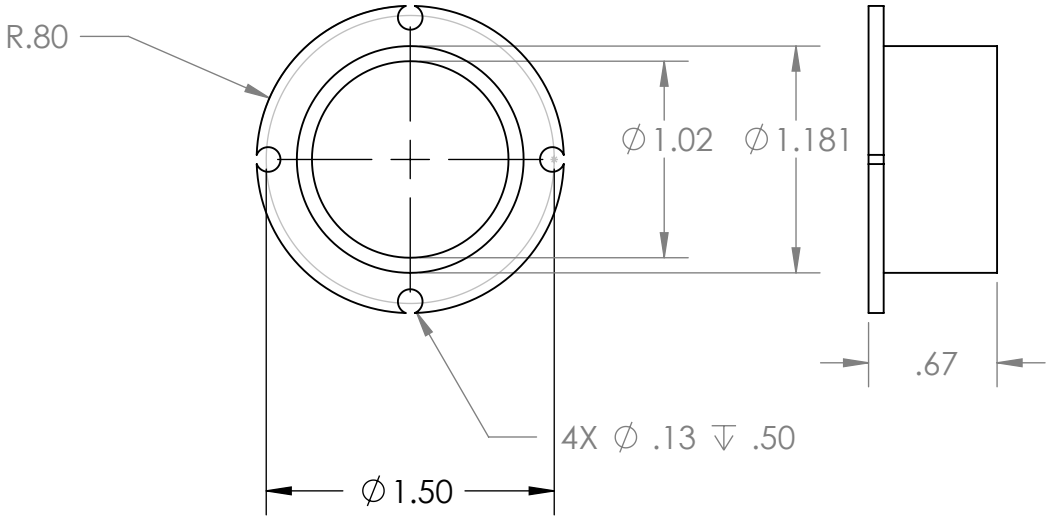
3D Print in PLA

Valve Plate #3 Fan Tunnel (Bottom)

SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA
Valve Plate #3 Fan Tunnel (Top)

SIZE	DWG. NO.	REV.
A	fan tunnel top(-30)	
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

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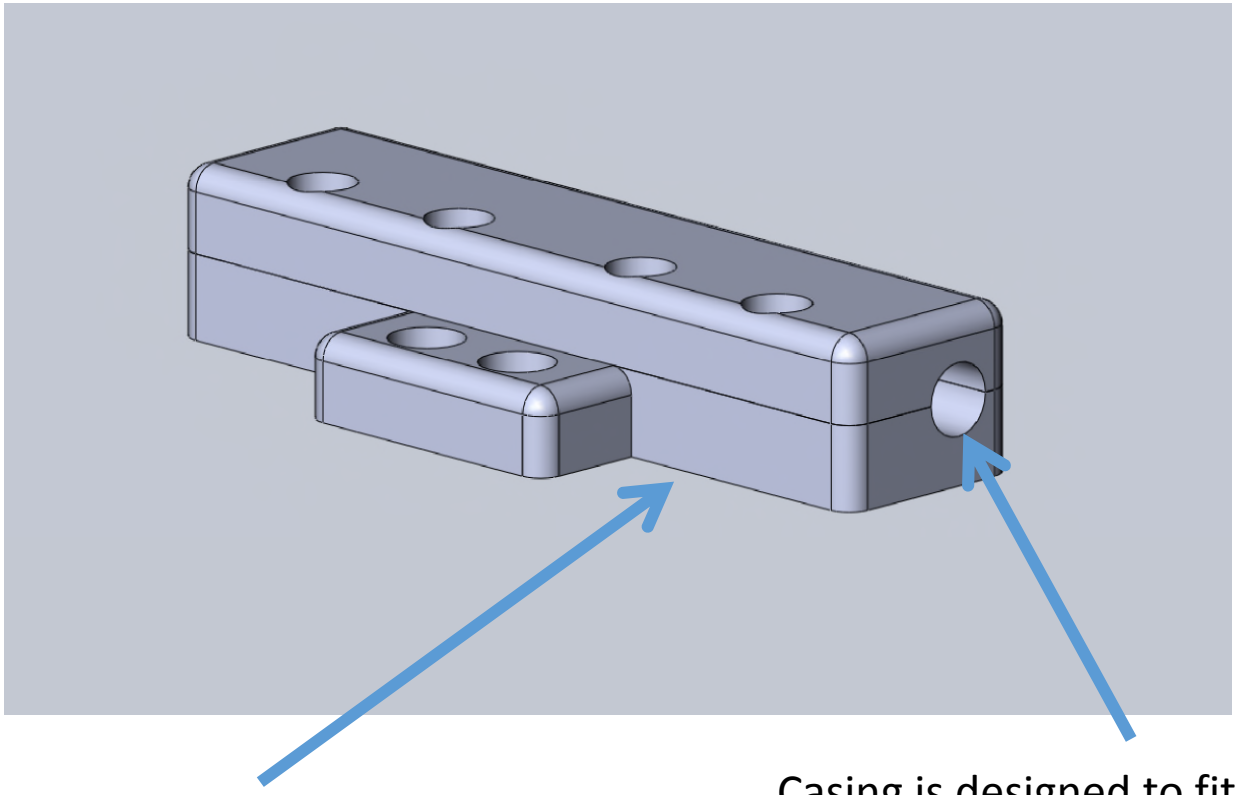
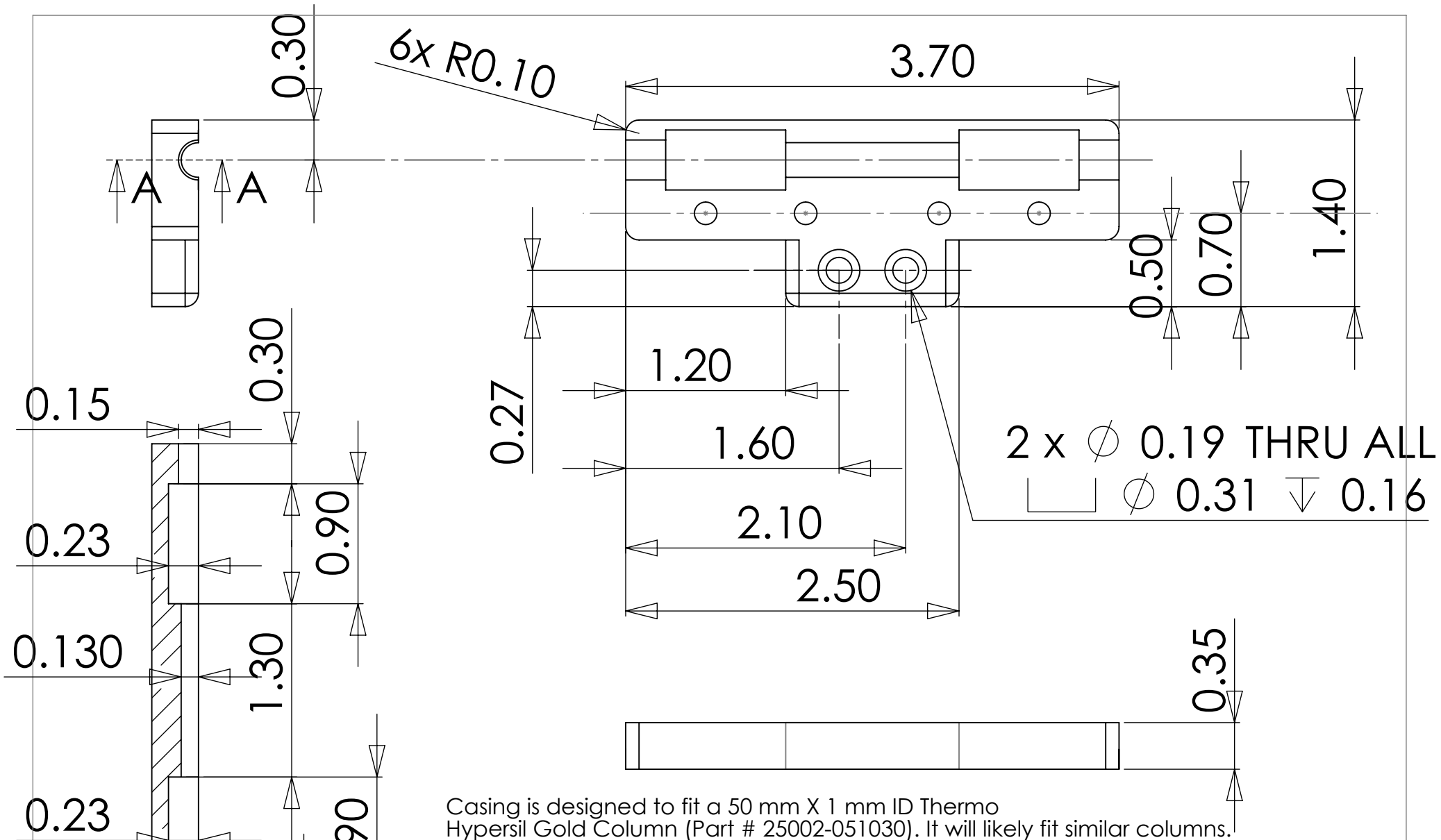
50 mm LC Column Housing (Page 1 of 5)



In hole insets on bottom, press-fit four 6-32 Inserts for Soft Metal (McMaster-Carr Part# 97191A150 or similar)

Casing is designed to fit a 50 mm X 1 mm ID Thermo Hypersil Gold Column (Part # 25002-051030). It will likely fit similar columns.

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Casing is designed to fit a 50 mm X 1 mm ID Thermo Hypersil Gold Column (Part # 25002-051030). It will likely fit similar columns.

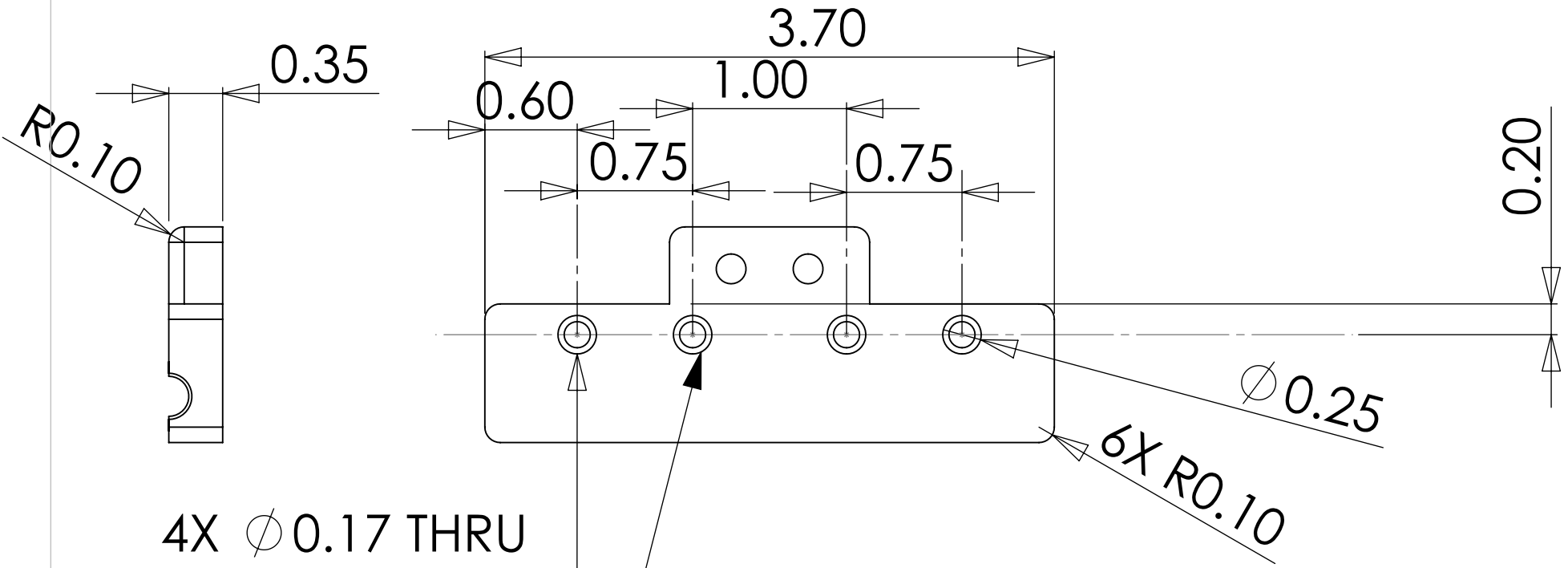
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
NEXT ASSY	USED ON	FINISH --	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

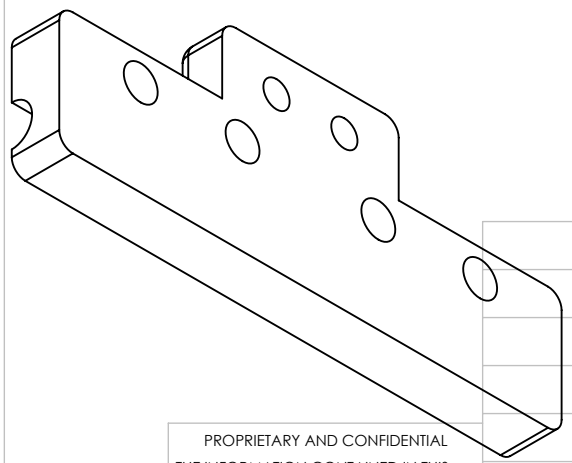
3D Print in Aluminum

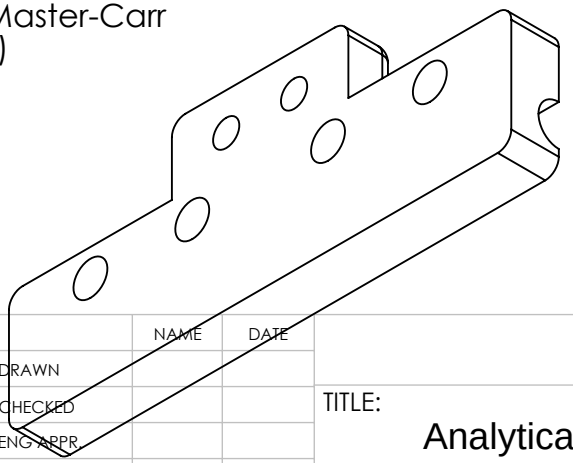
Analytical Column Mount Base(50 mm), p 1/2

SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 2

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485







		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

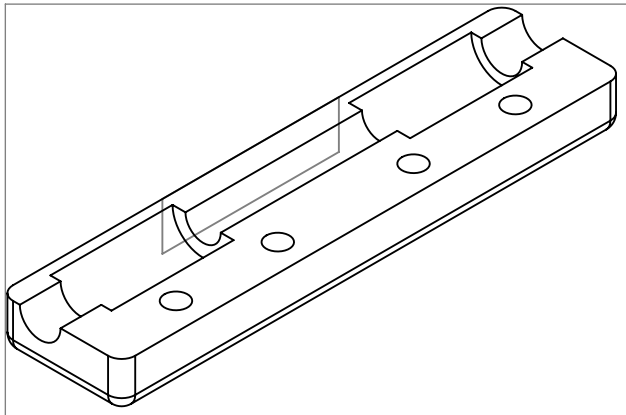
TITLE: Analytical Column Mount Base(50 mm), p 2/2

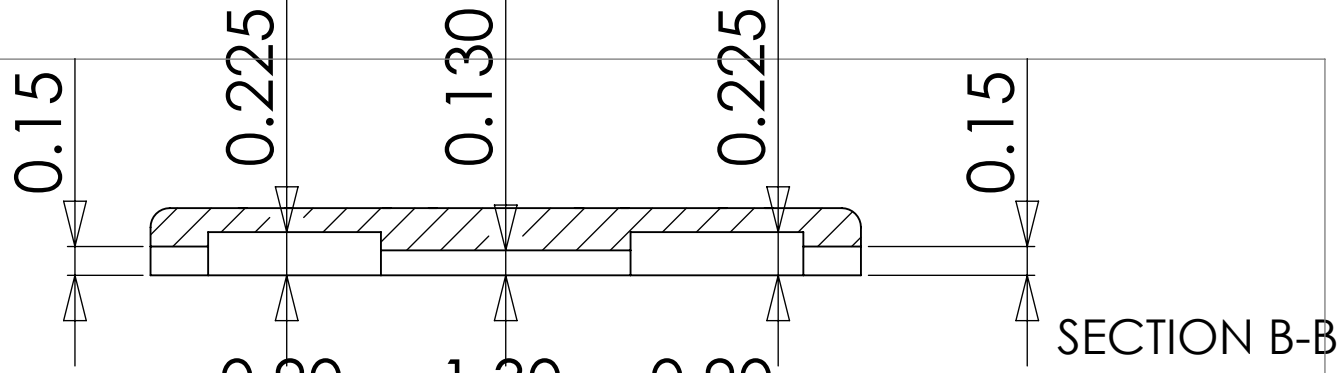
SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 2 OF 2

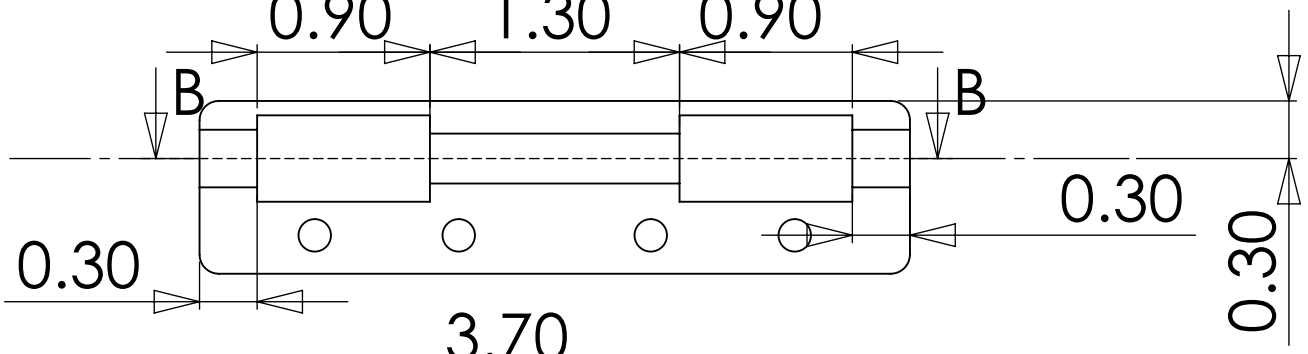
5 4 3 2 1

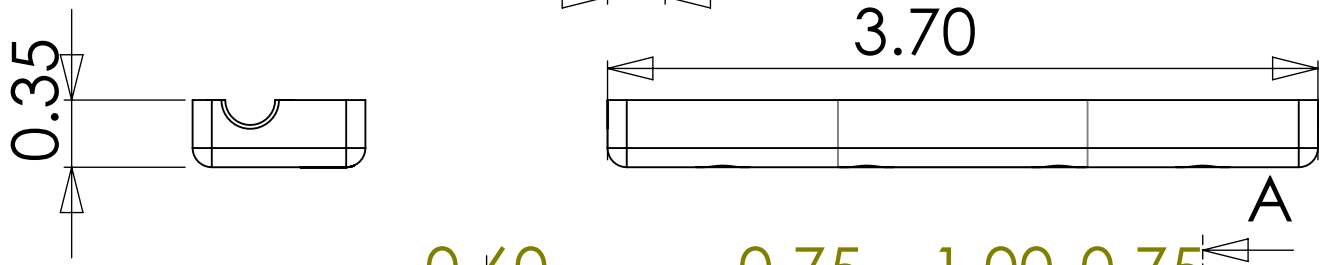
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



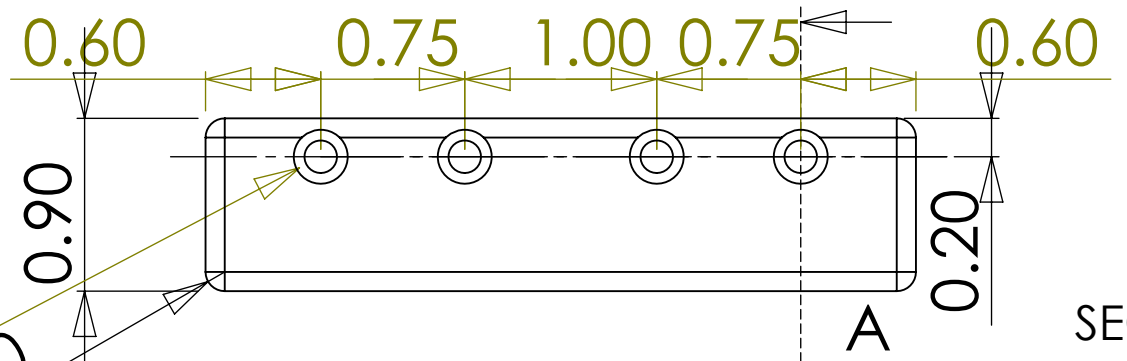


SECTION B-B

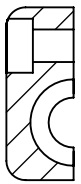




A



A



SECTION A-A

4X ⌀0.14 THRU
⌴ ⌀0.25↧0.23

4X R0.10

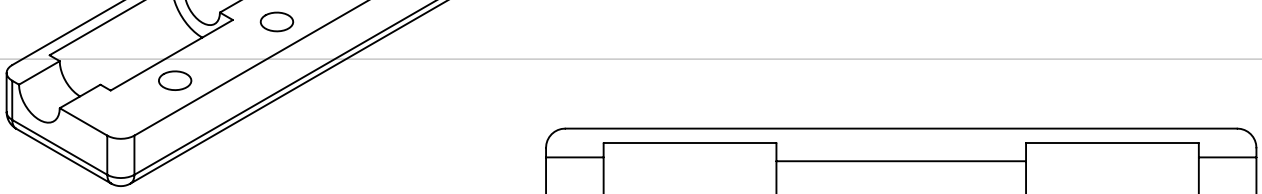
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
			COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

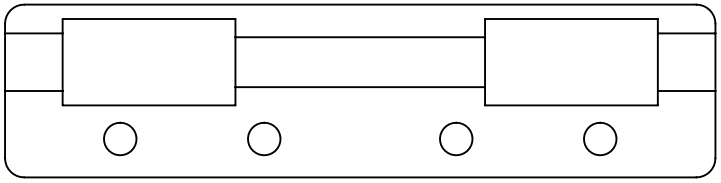
3D Print in Aluminum

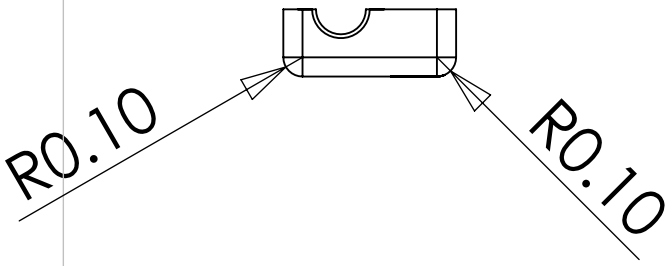
Analytical Column Mount Cover(50 mm), p 1/2

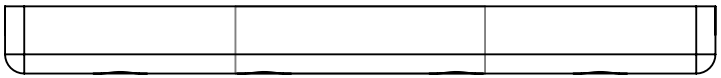
SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 2

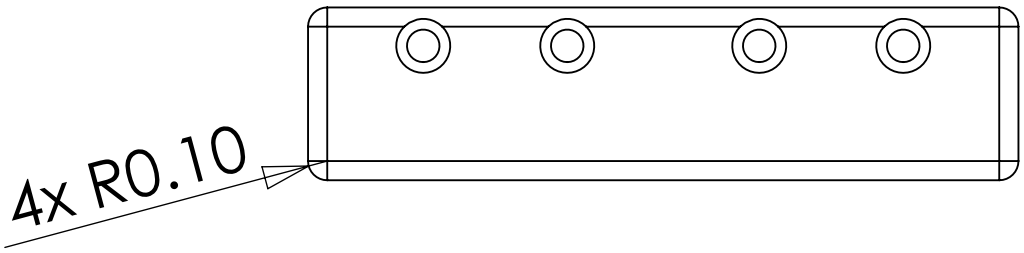
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485











		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH	•		
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Analytical Column Mount Cover (50 mm), p 2/2

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 2 OF 2

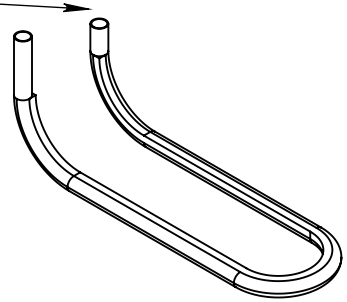
5 4 3 2 1

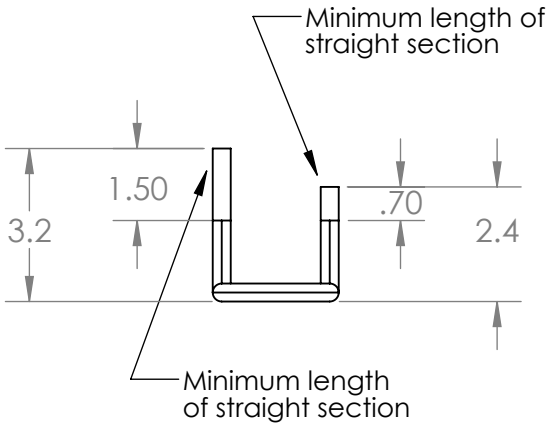
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

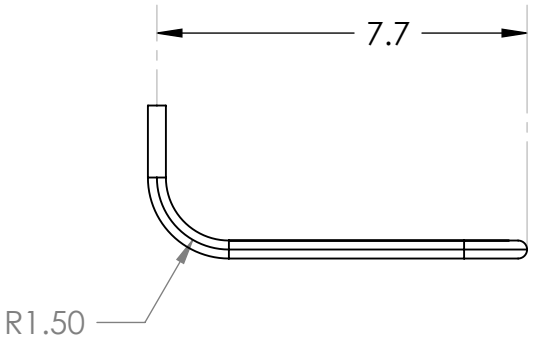
I recommend silver-soldering a right-angle connector & a piece of 3/8" tube extending to liquid source.

(But maybe not, as not using Swagelock elbows will make assembly awkward but still feasible.

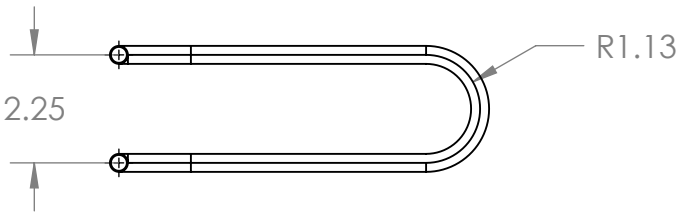
The prototype used Swagelock elbows.)







In spite of appearances, this is 316/316L seamless stainless steel tube 3/8"x 0035" wall.



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Valve Plate #3 Coolng Tube
(JWH: 6-4-2016}

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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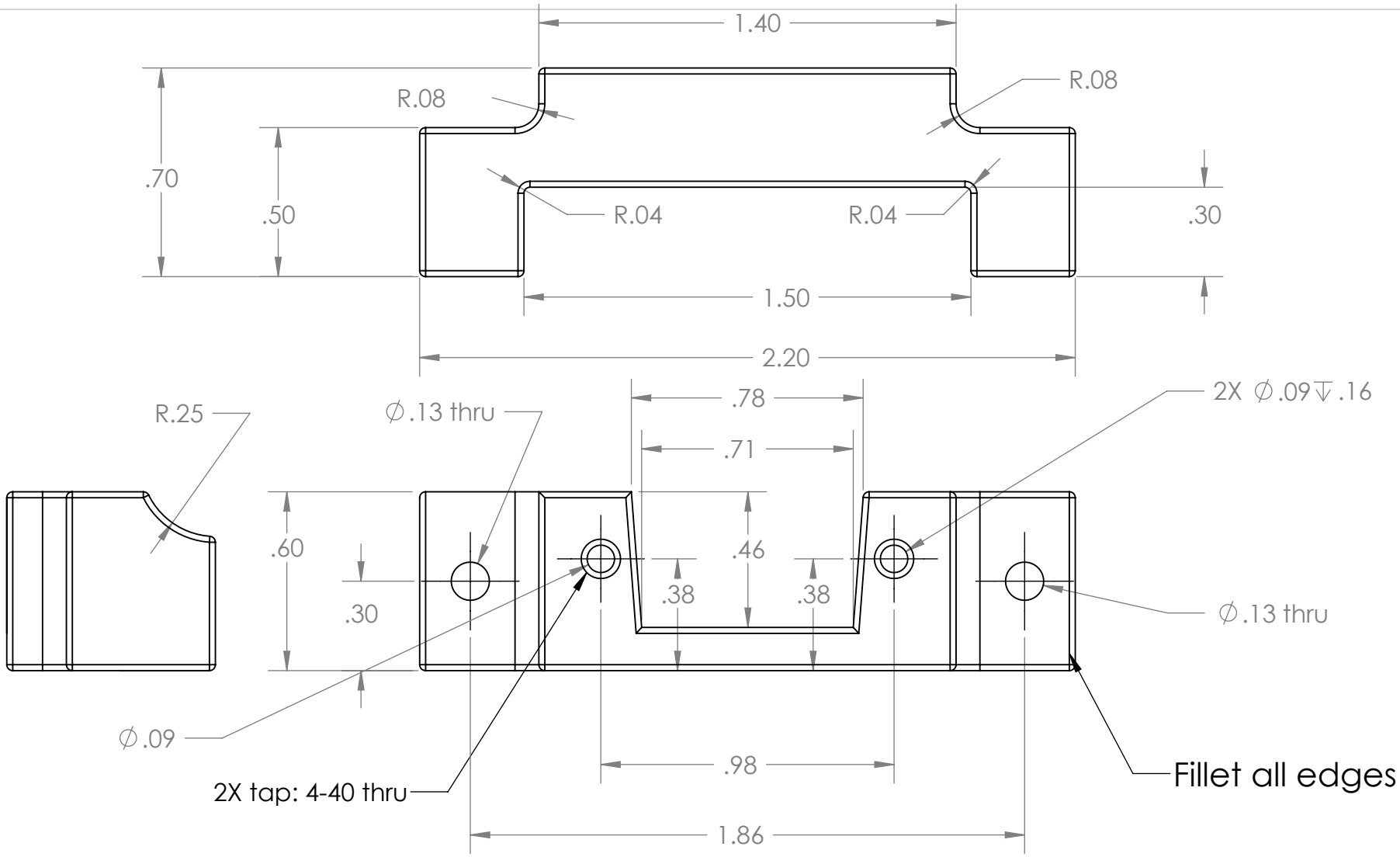

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

TITLE:

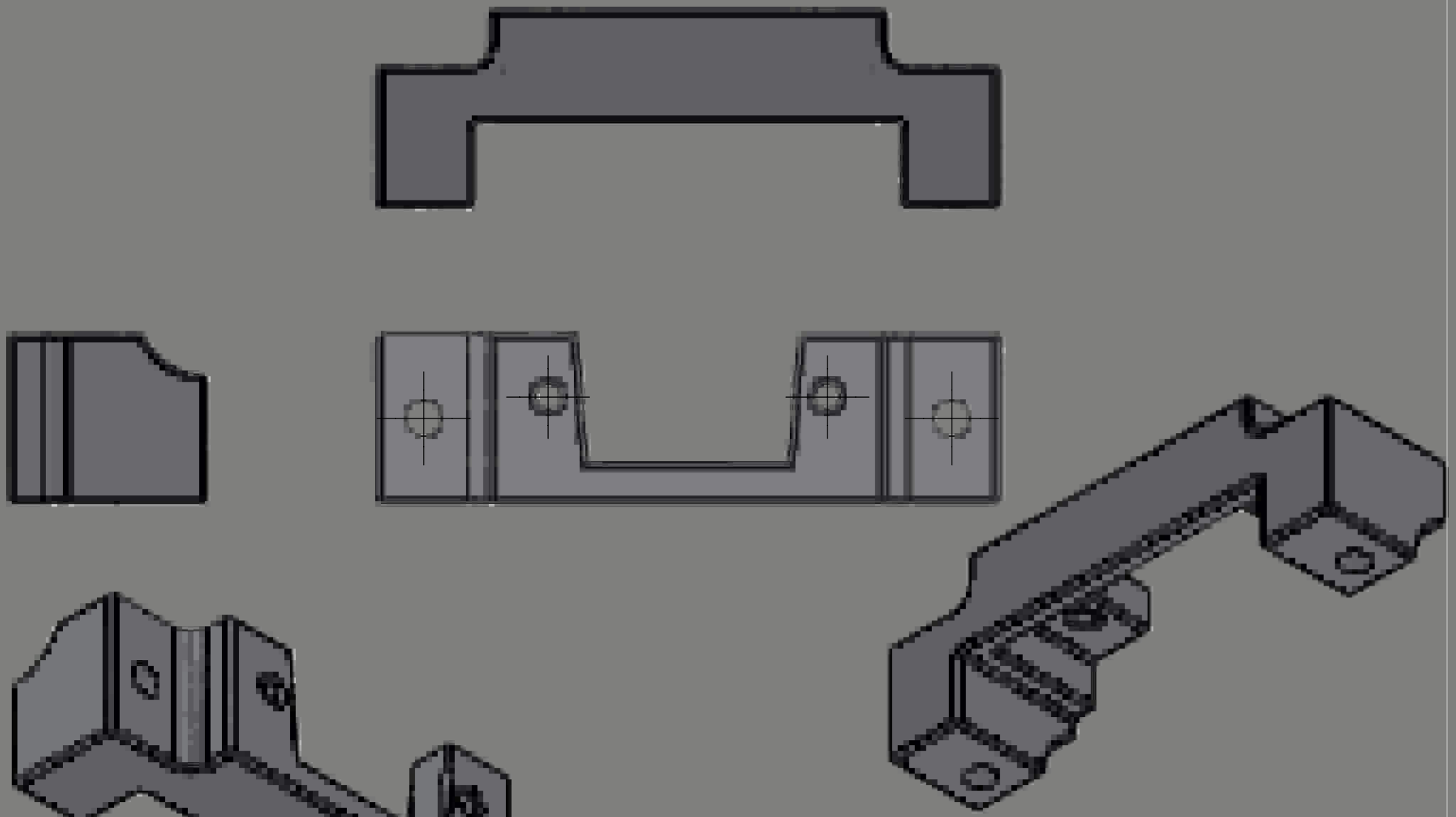
D-SUB 9-pin Mount (page 1 of 2)

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 1 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		NAME	DATE
DRAWN			
CHECKED			
ENG APPR.			
MFG APPR.			
Q.A.			

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

COMMENTS:

TITLE: D-SUB 9-pin Mount (page 2 of 2)

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 2 OF 2

NEXT ASSY | USED ON

APPLICATION

5 4 3 2 1

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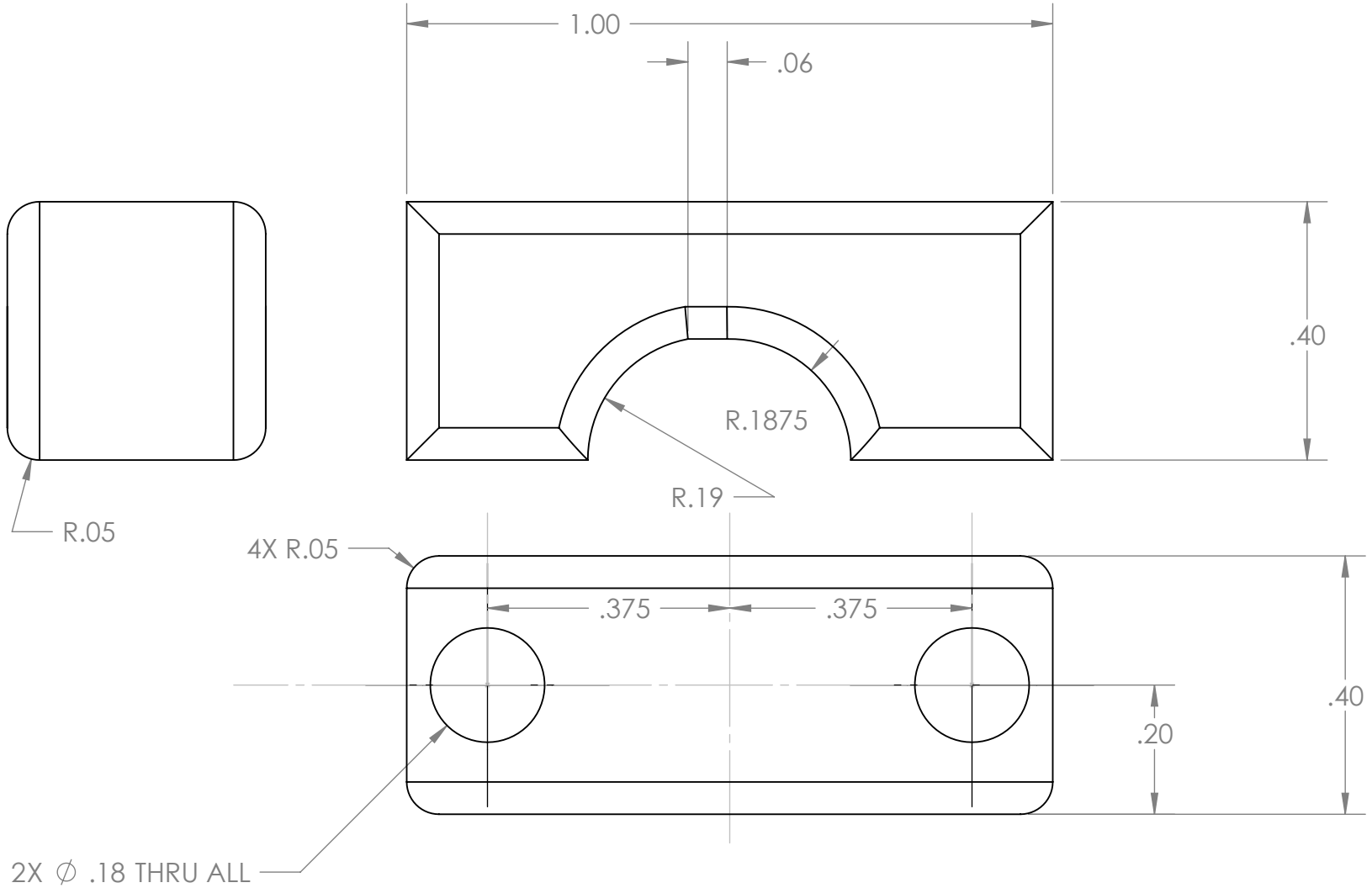


		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Make 16

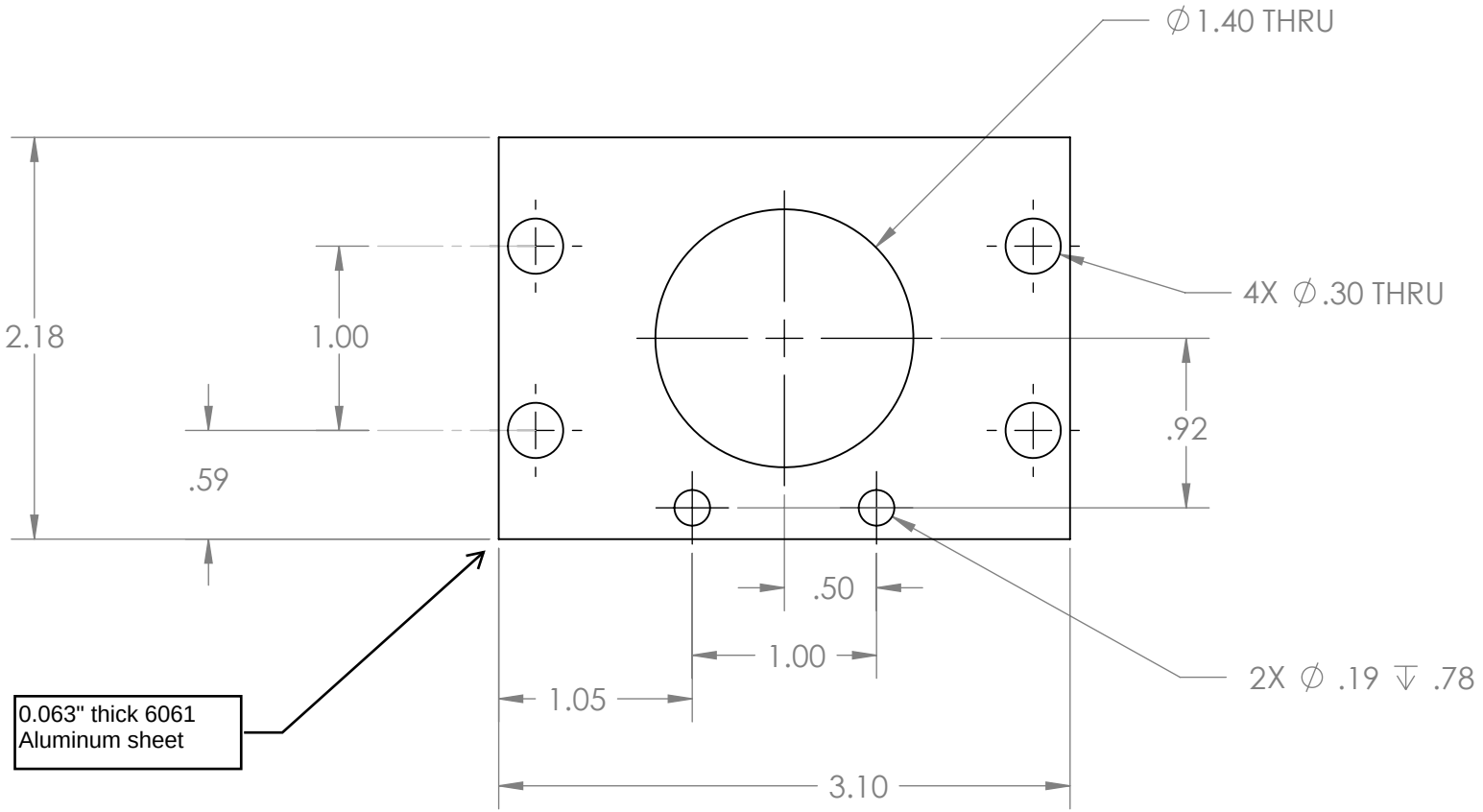
TITLE: Cooling tube clamp JWH: 4-1-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 4:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Make 4

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 0.063" 6061 Al sheet

TITLE:

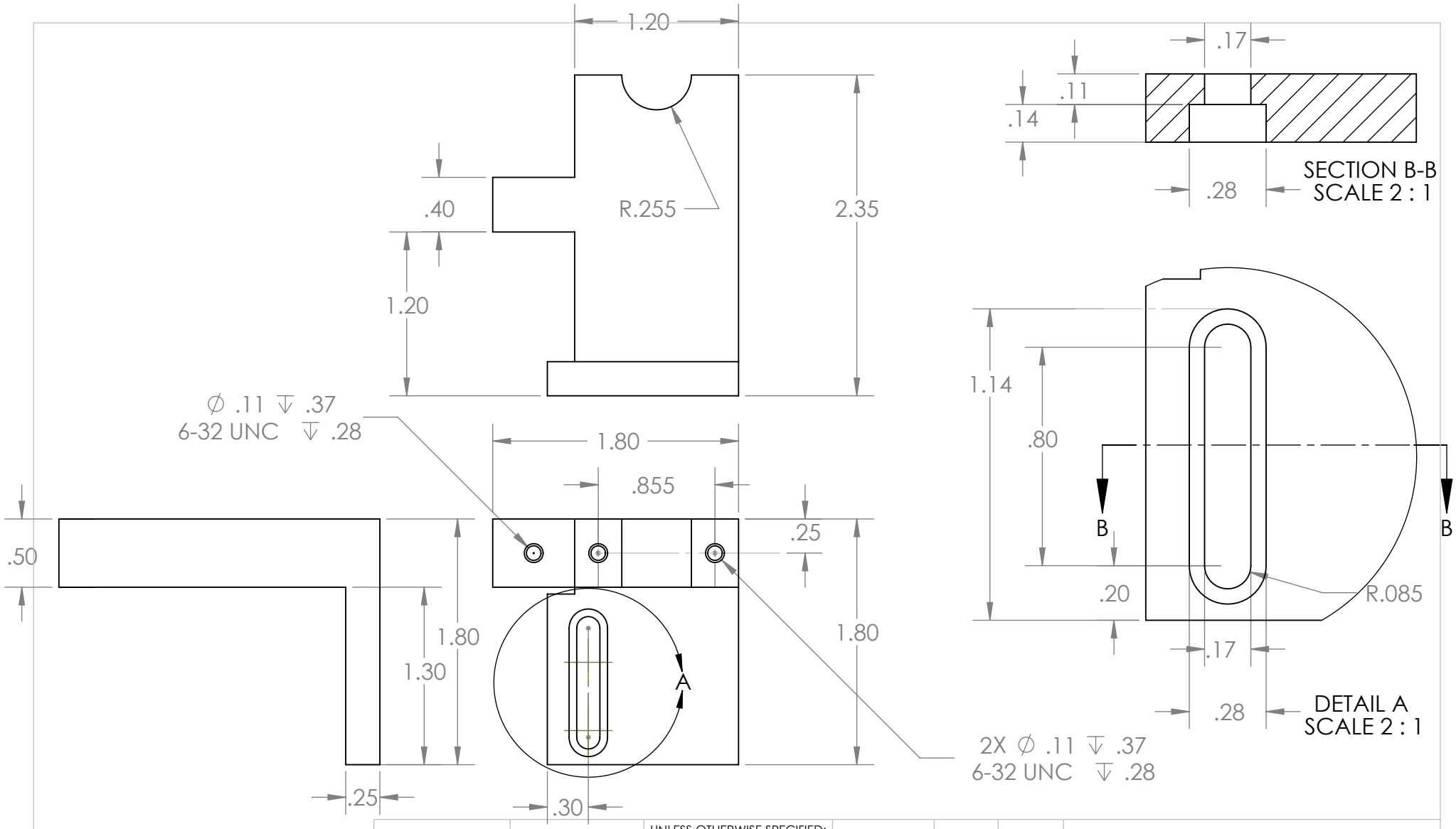
Actuator Base 5-5-2016

SIZE	DWG. NO.	REV
A	Actuator-EH	

SCALE: 1:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 Al

TITLE:

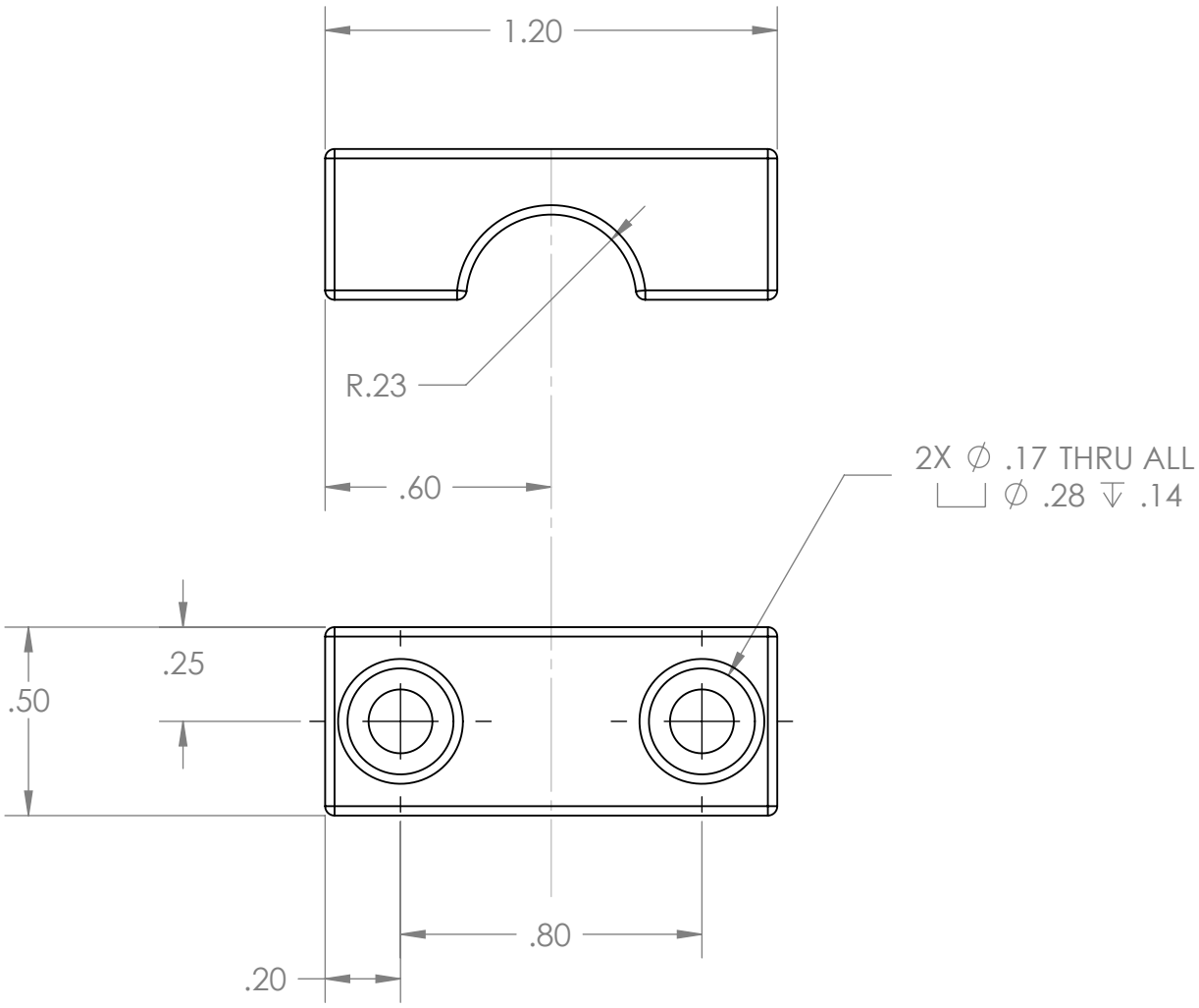
Guard Trap Mount

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL	Q.A.		
NEXT ASSY	USED ON	FINISH	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

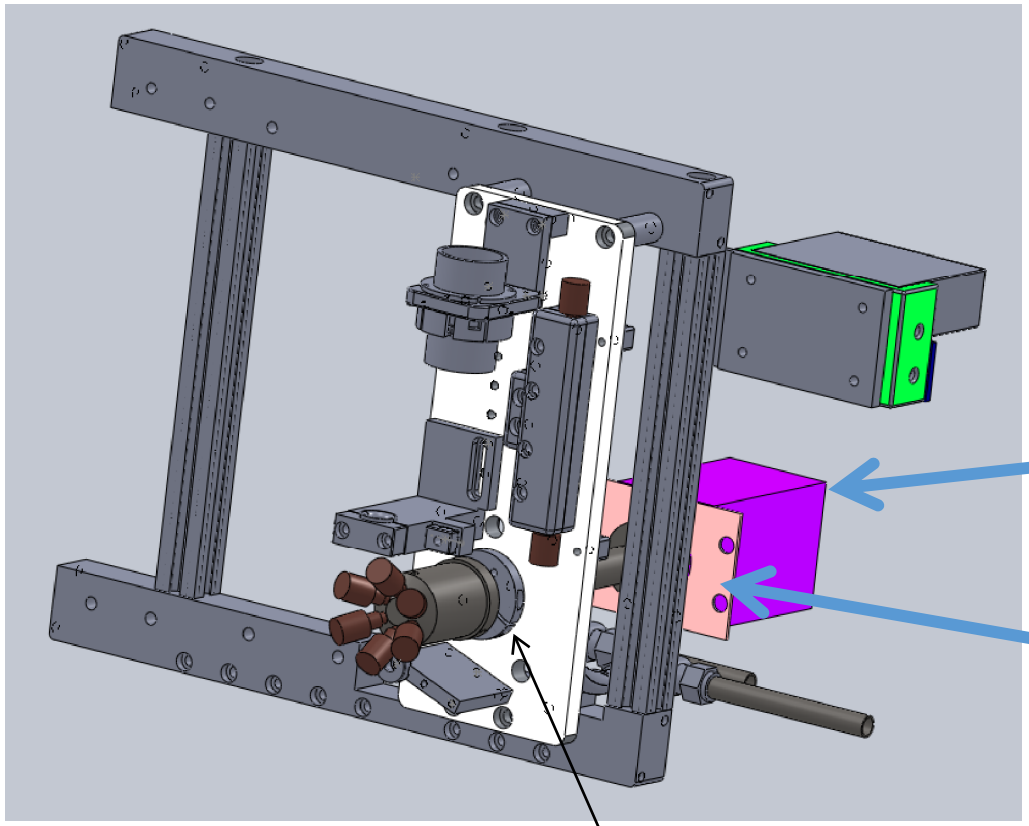
Material: Aluminum

Mixer Clamp

SIZE	DWG. NO.	REV.
A	mixer clamp	
SCALE:2:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Valve #3 Plate Mounted on Frame



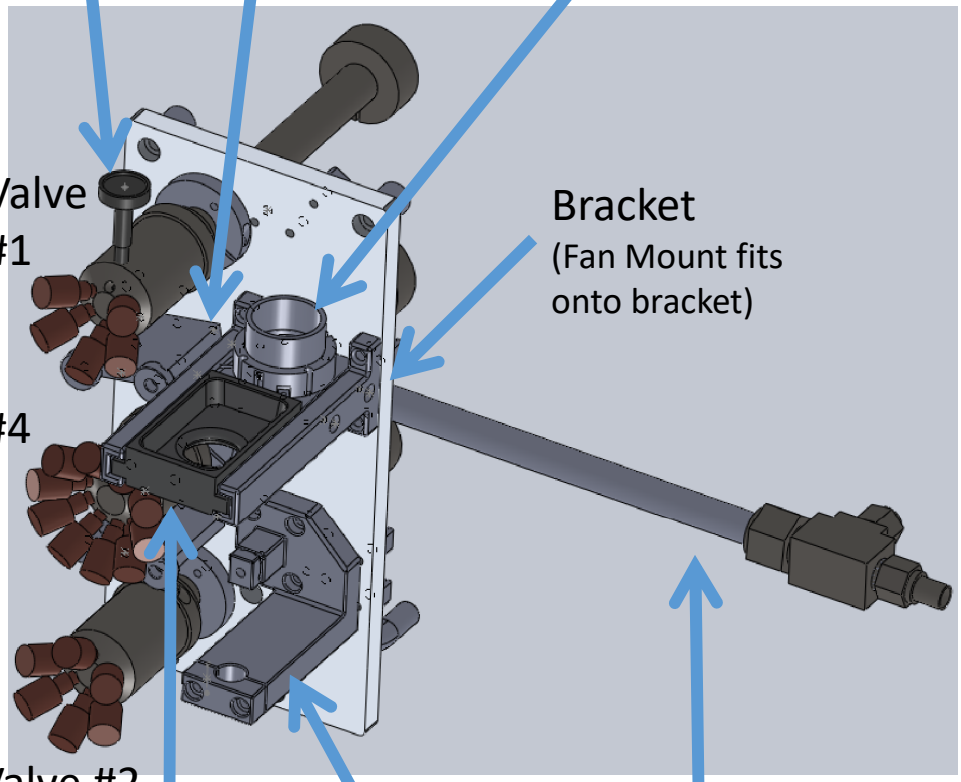
Vendor's Valve
Actuator Motor

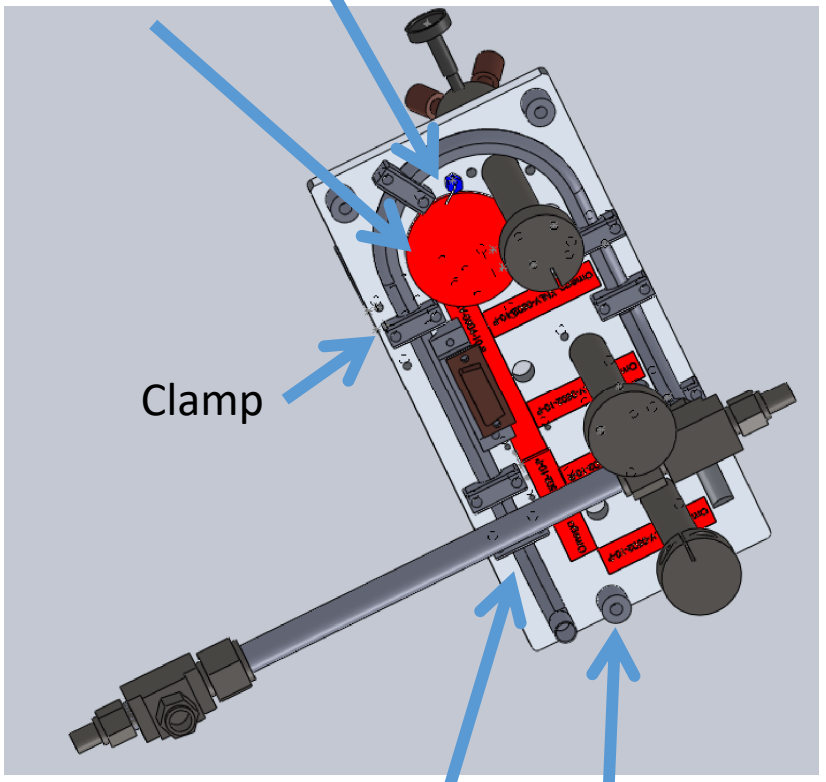
Actuator Mounting Plate
Drawing: *"Actuator Base"*

Collar is fastened to plate with 8-32 socket head screws. (This piece is not essential and can be eliminated.)

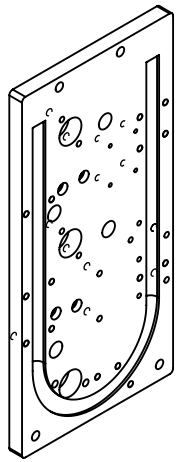
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

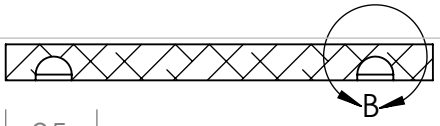
0 °C Chamber Plate Assembly



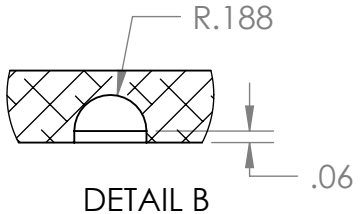


Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





SECTION A-A
SCALE 1 : 2



DETAIL B
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

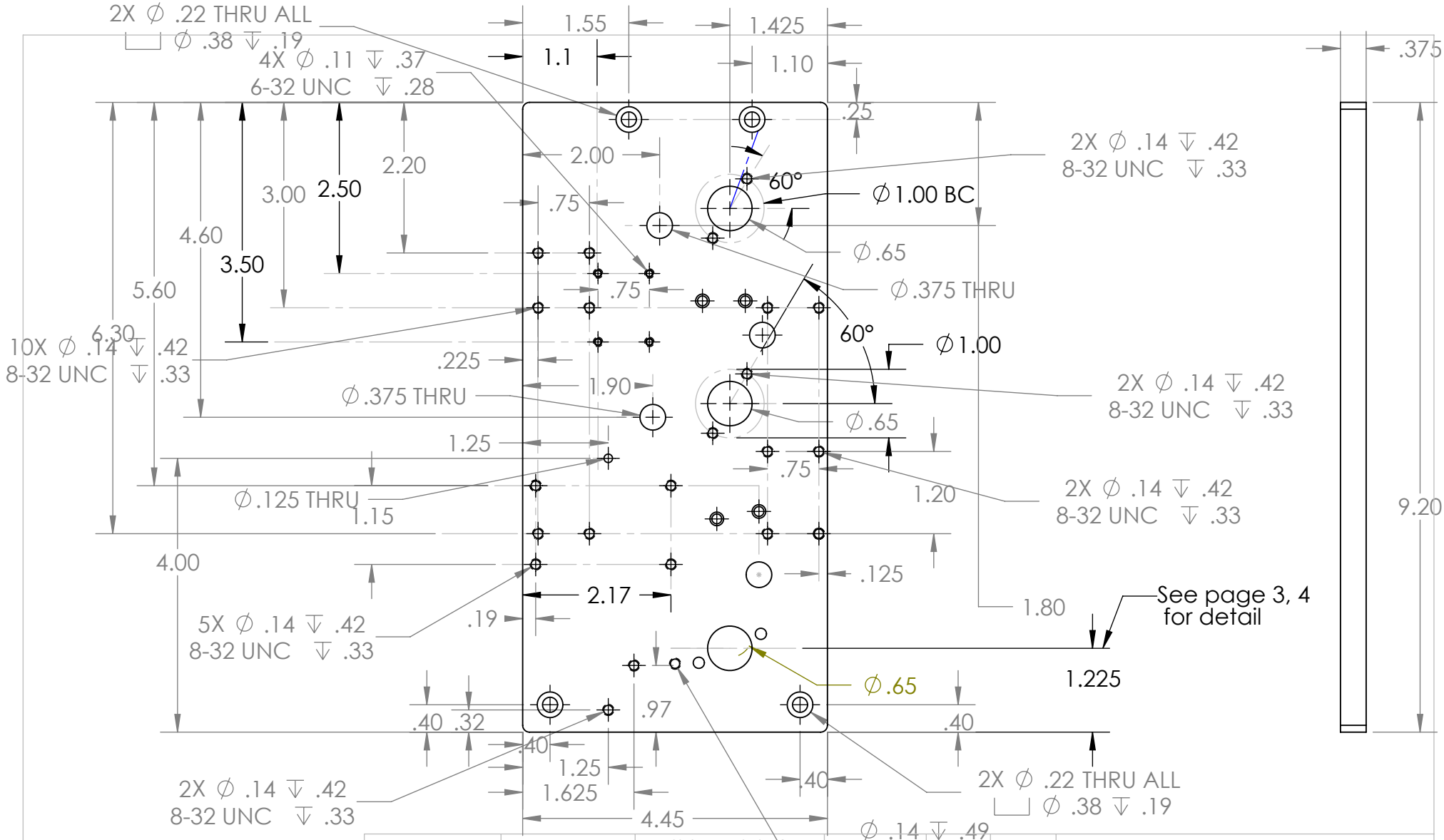
TITLE: Valve Plate #2 (JWH:3-31-2016)

SIZE	DWG. NO.	REV
A	.	

SCALE: 1:4 WEIGHT: SHEET 1 OF 4

5 4 3 2 1

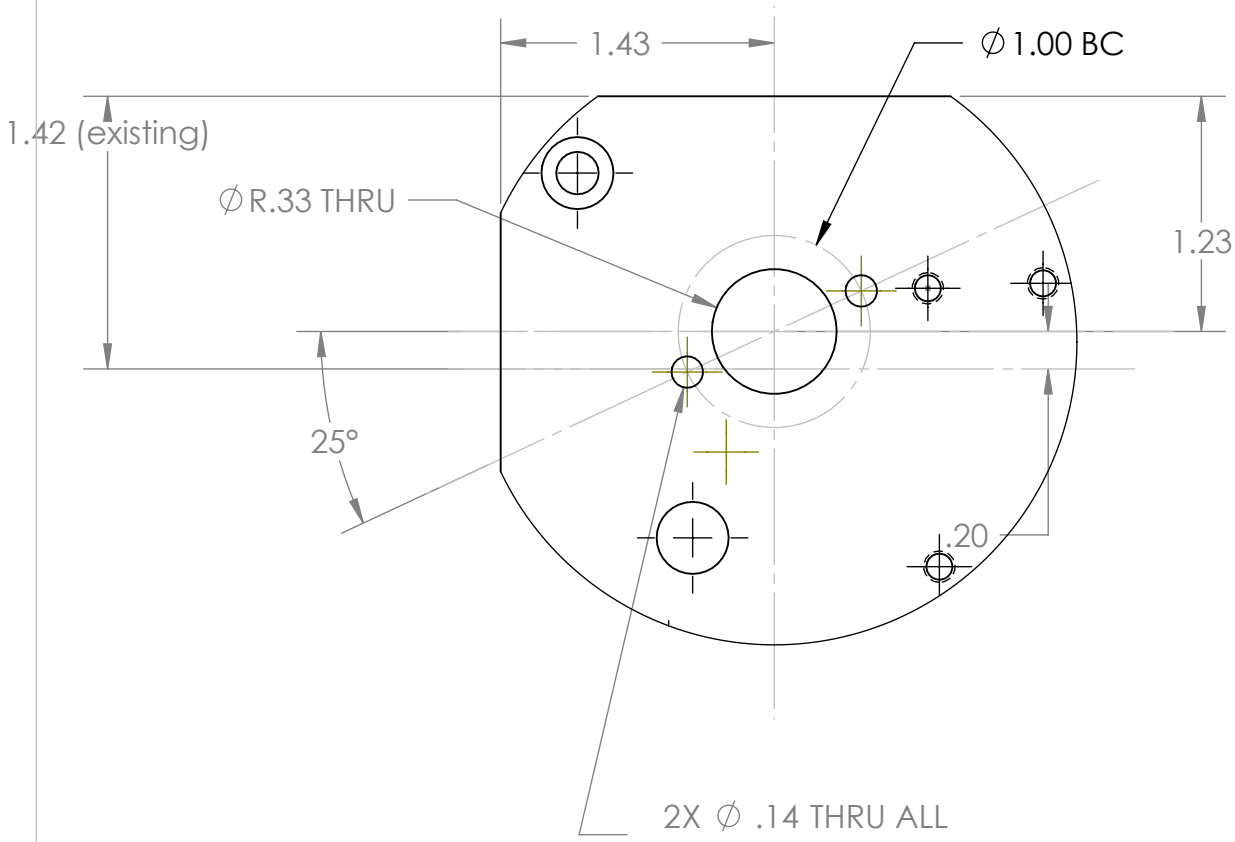
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

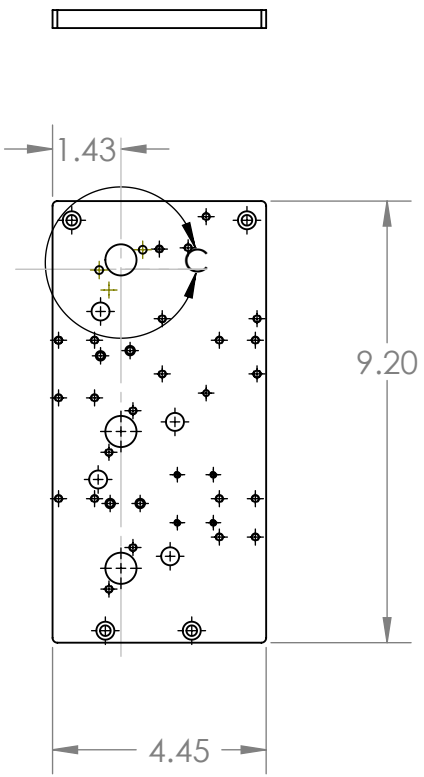


		UNLESS OTHERWISE SPECIFIED:	NAME	DATE	
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		TITLE: Valve Plate #2 (JWH:5-5-2016)
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		SIZE A / DWG. NO. . / REV
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			SCALE: 1:4 WEIGHT: SHEET 2 OF 4

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
DETAIL C SCALE 1 : 1		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

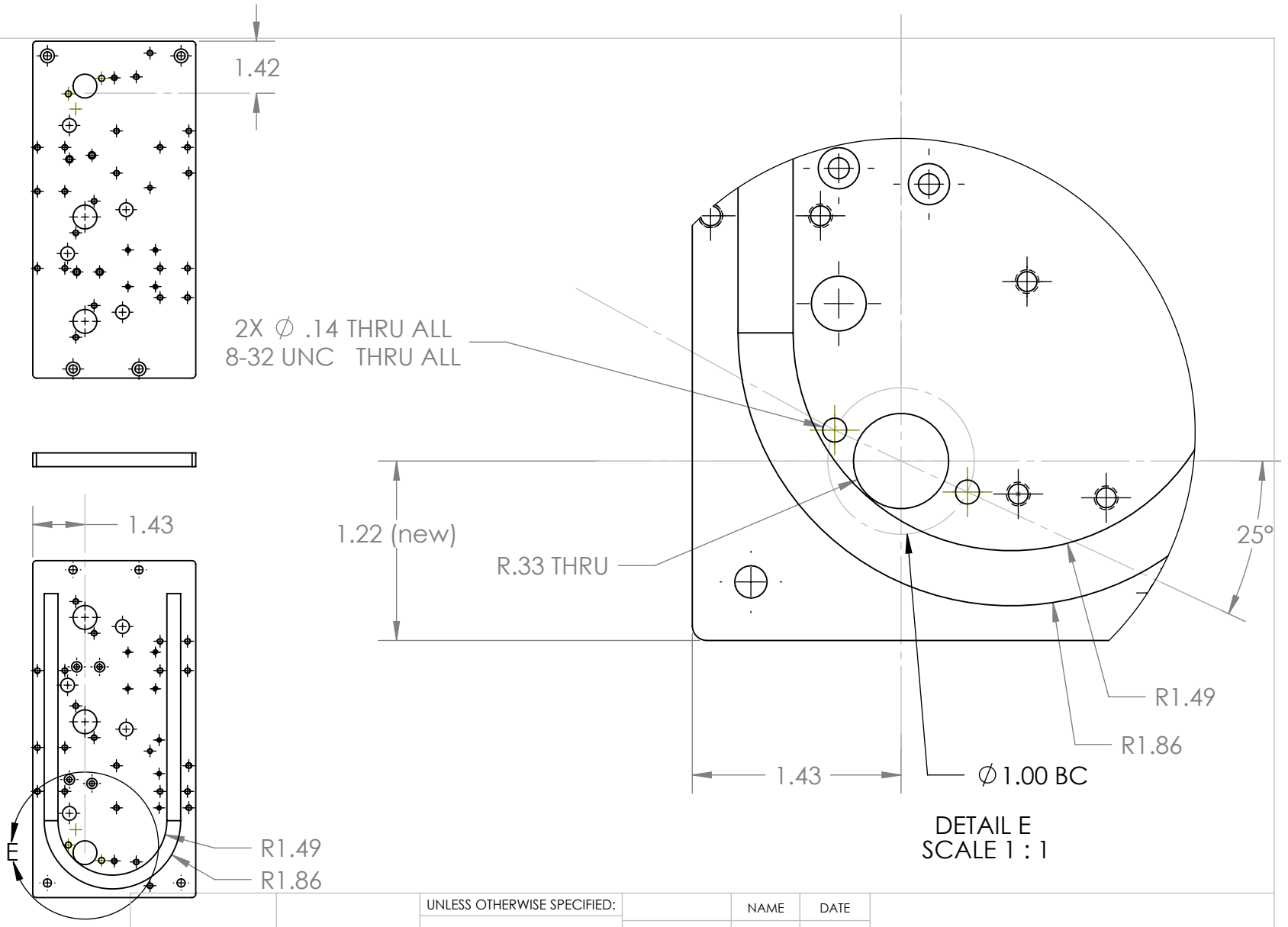
TITLE: Modifications to 3-in-plate (5-30-2016)

SIZE	DWG. NO.	REV
A	.	

SCALE: 1:4 WEIGHT: SHEET 3 OF 4

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



DETAIL E
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

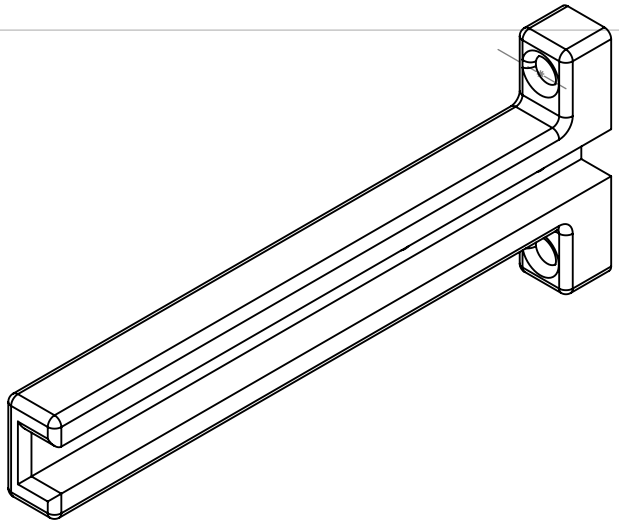
3-in-plate (5-30-2916)

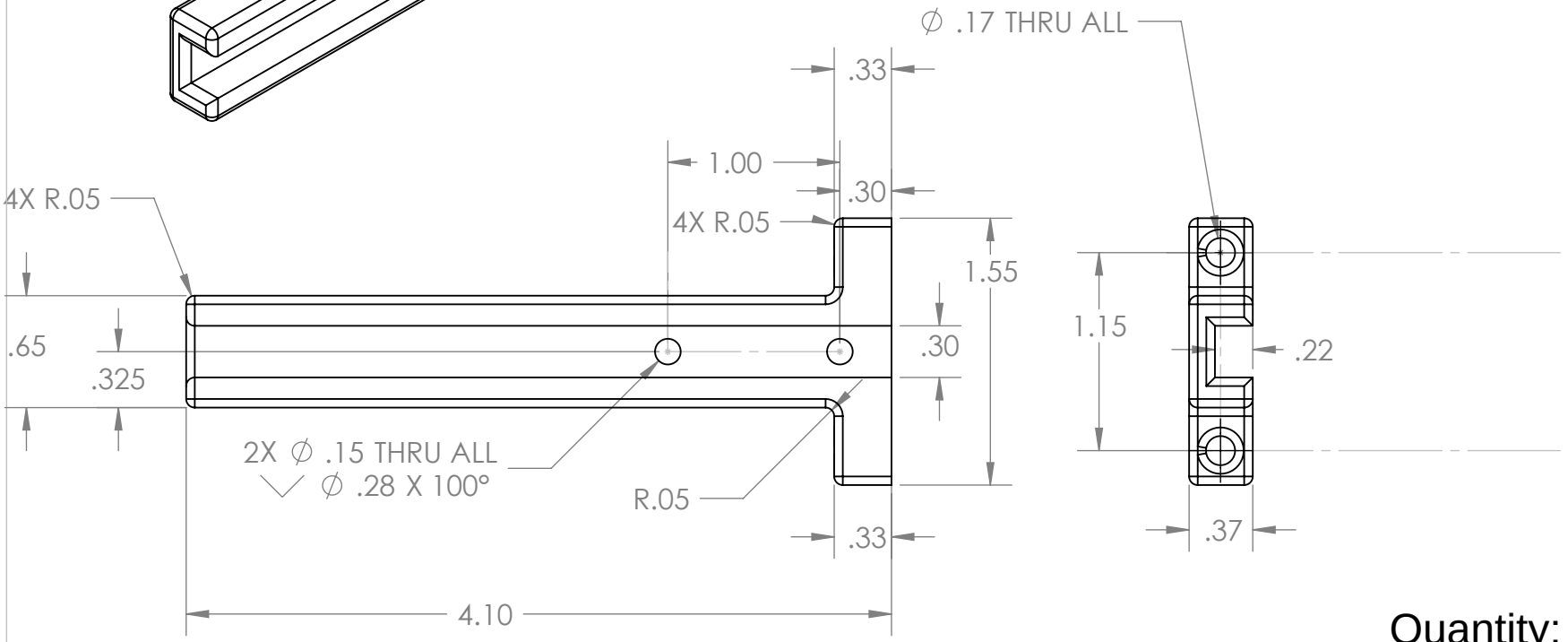
SIZE	DWG. NO.	REV
A	.	

SCALE: 1:4 WEIGHT: SHEET 4 OF 4

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





Quantity: 2

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 Aluminum

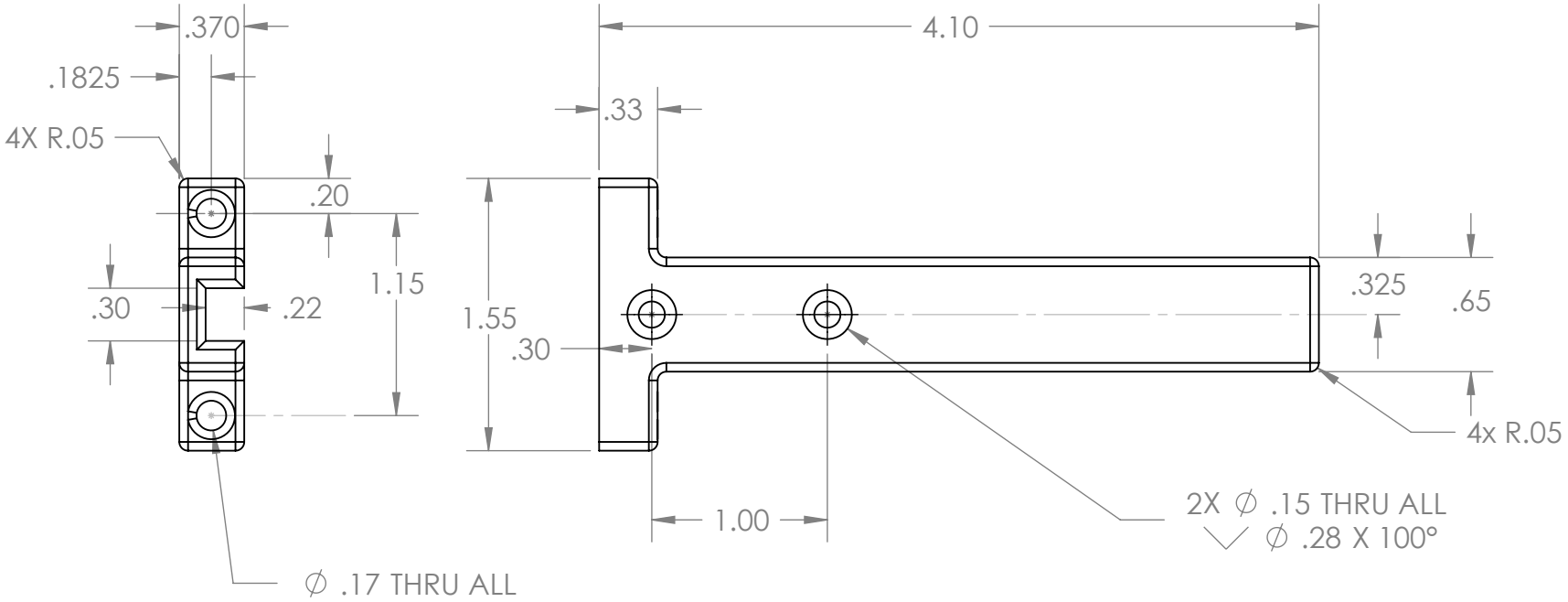
TITLE: Bracket (Plate #2)

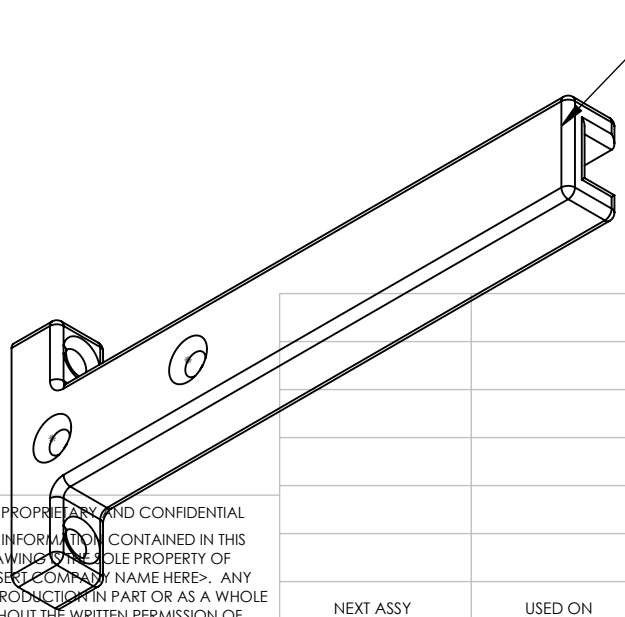
SIZE	DWG. NO.	REV
A		

SCALE: 1:1 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

TITLE:
B racket (Plate #2)
(JWH: 5-10-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

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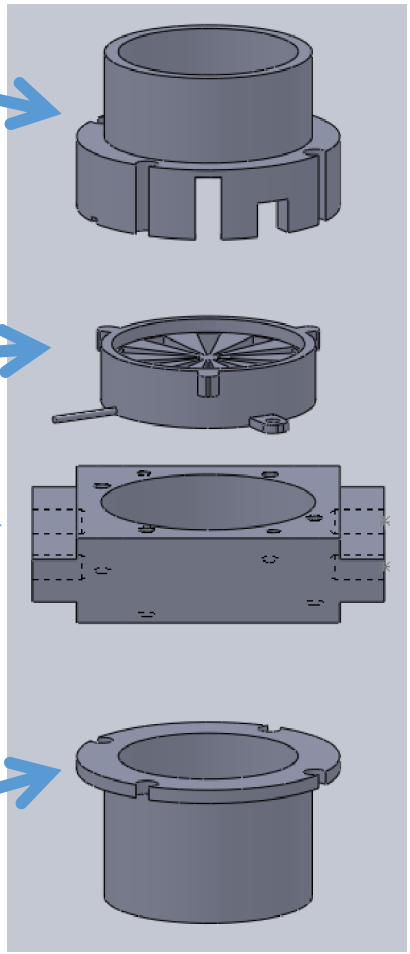
Plate #2 Fan Assembly

Valve Plate #2 Fan Tunnel (Top)

Model BRA-3008, BRA3008 Micro Fan {PTI Pelonis Technologies, Inc (http://catalog.pelonistechnologies.com//)]

Fan Mount (Plate #2)

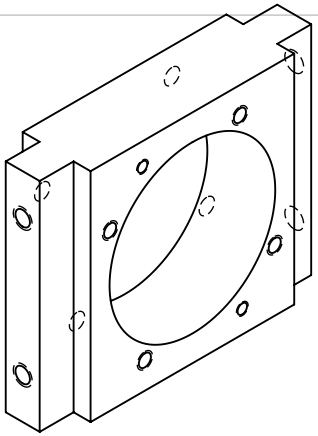
Valve Plate #2 Fan Tunnel (Bottom)

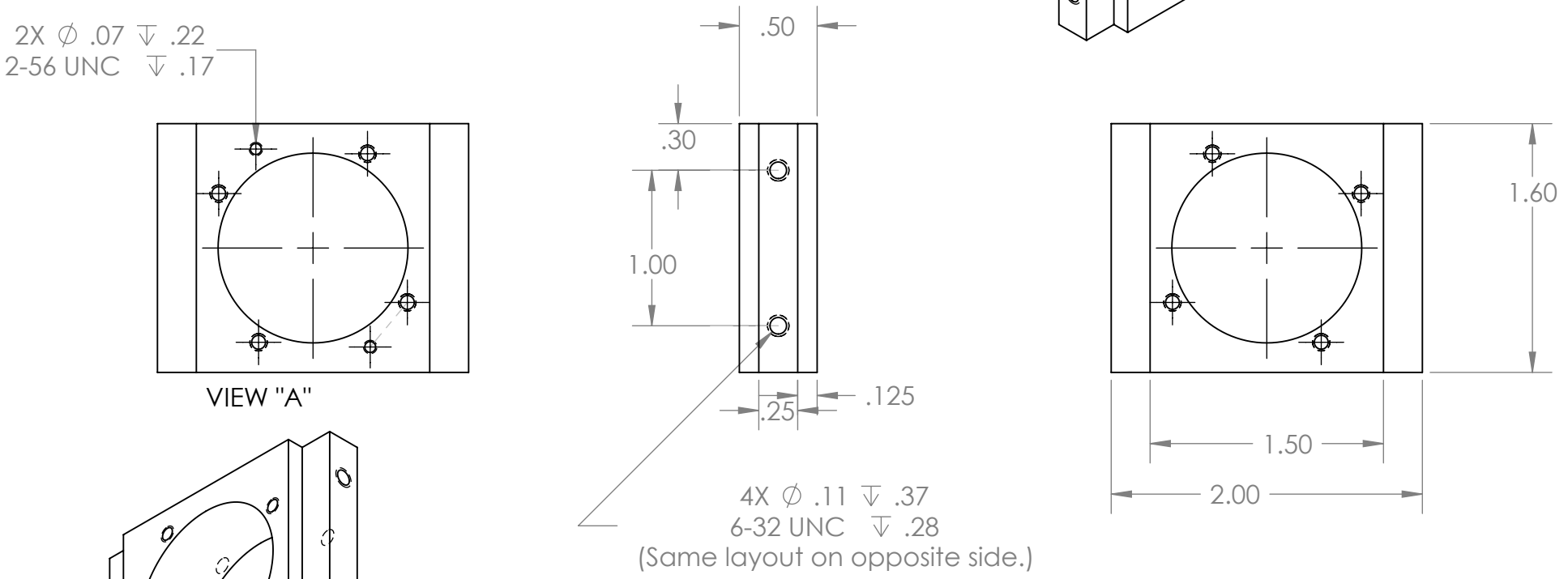


Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

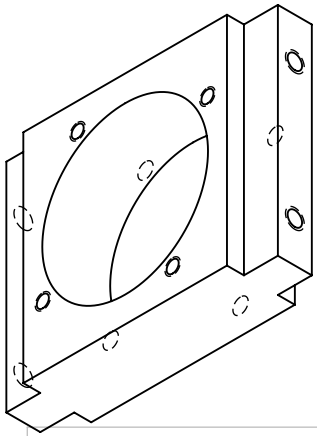
Location of tapped holes with reference to View "A".

B.C. (inch)	Angle (deg.)	Tap	Depth
1.40	30	4-40	thru
1.40	120	4.40	thru
1.48	150	2-56	0.20
1.40	210	4-40	thru
1.40	300	4-40	thru
1.48	330	2.56	0.20





VIEW "A"



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:
Fan Mount (Plate #2)
4-10-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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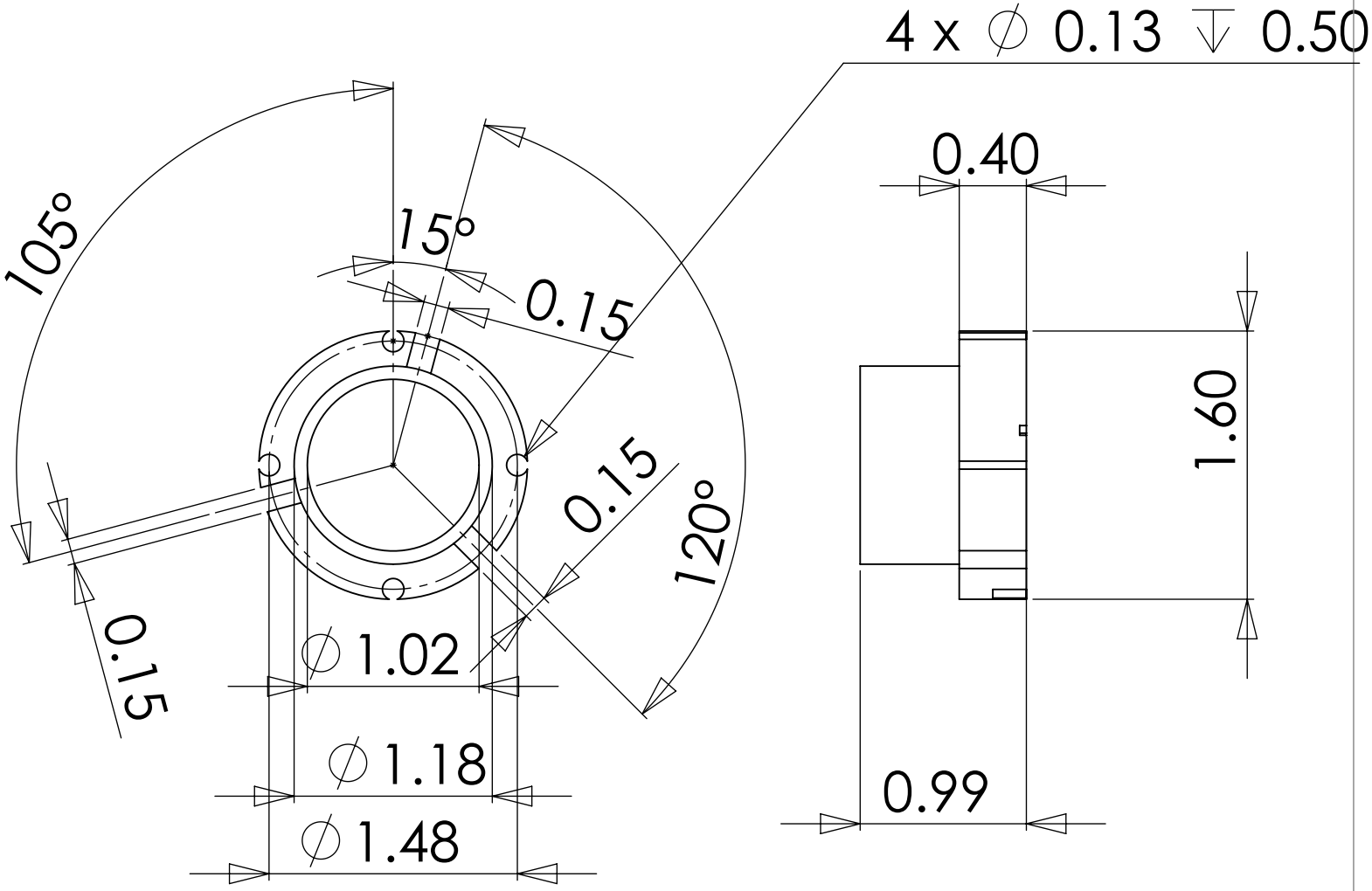


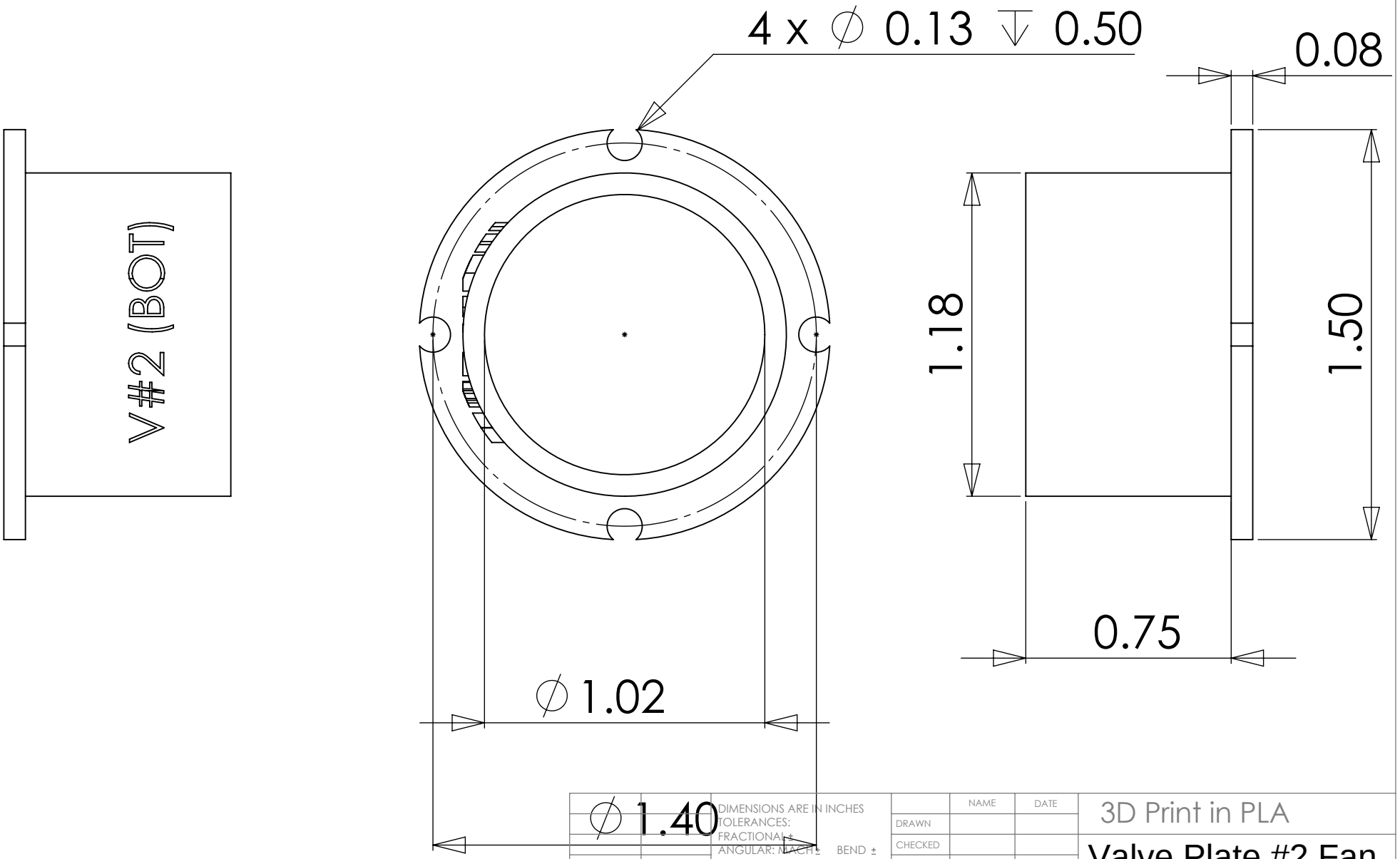
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

Valve Plate #2 Fan Tunnel (Top)

SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



NEXT ASSY	USED ON		
APPLICATION			

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL --

FINISH --

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

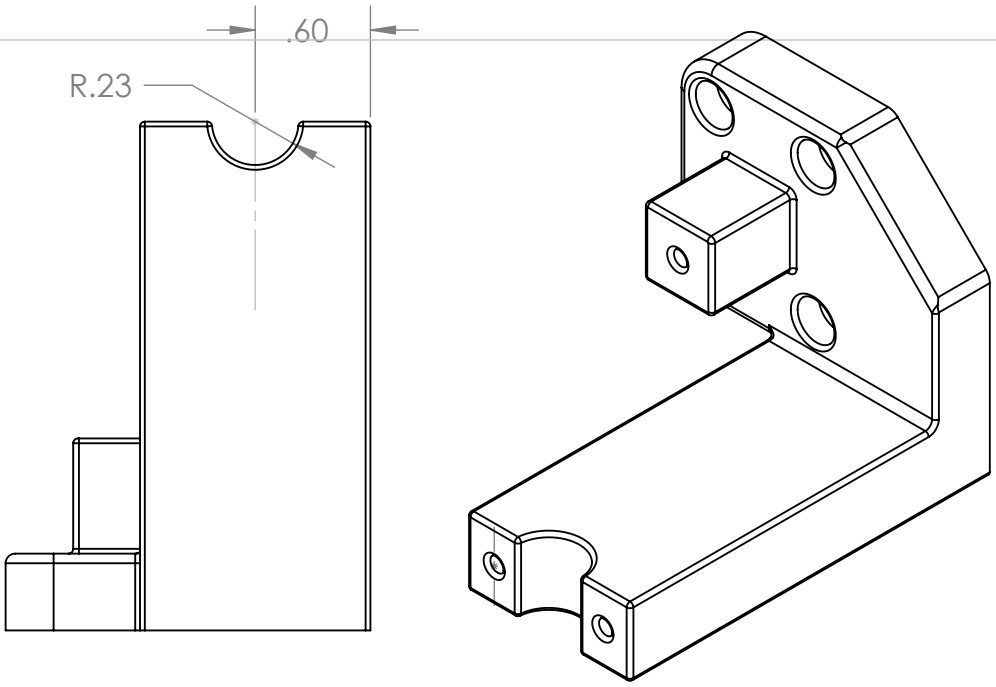
3D Print in PLA

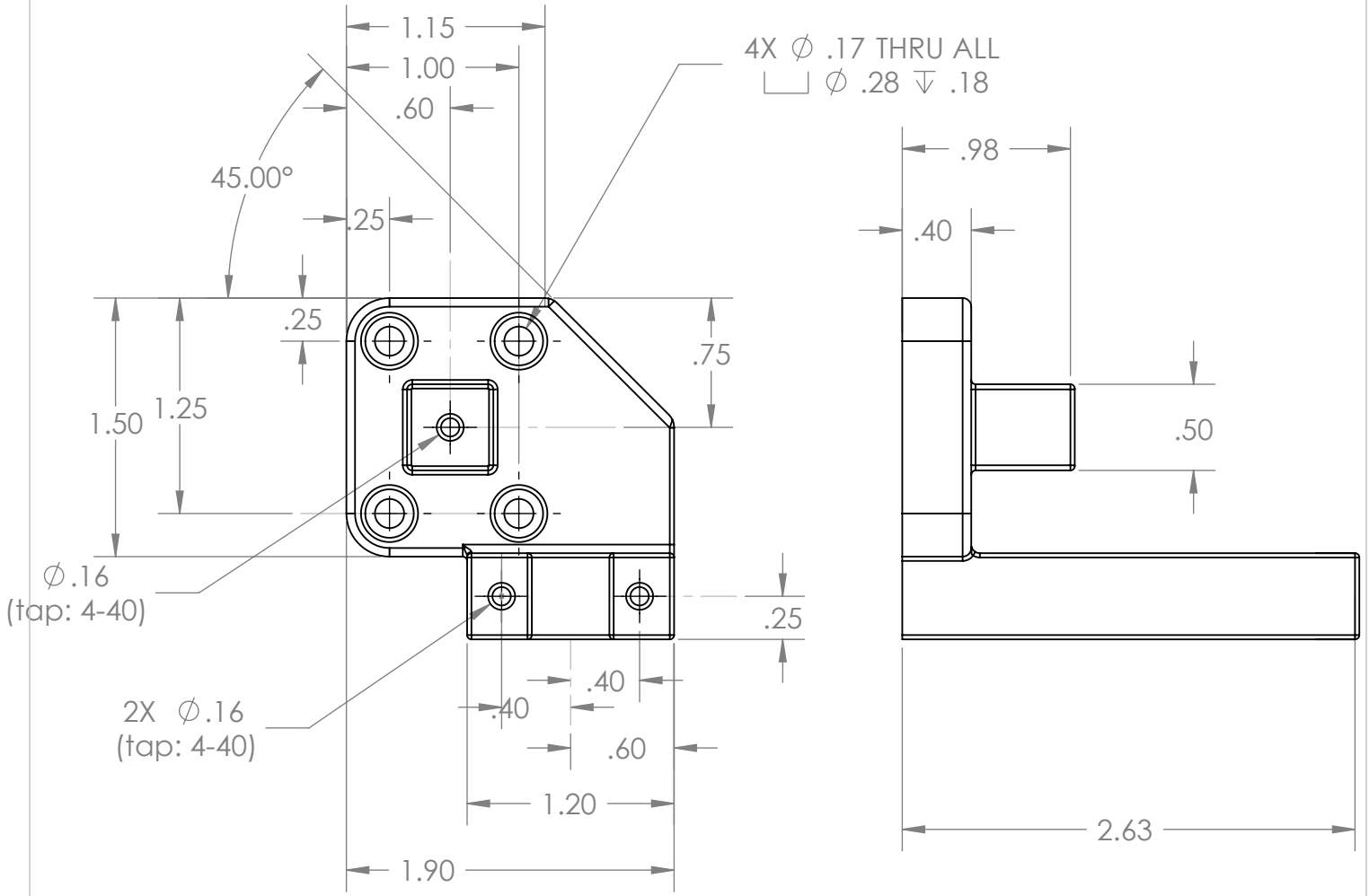
Valve Plate #2 Fan Tunnel (Bottom)

SIZE	DWG. NO.	REV.
A		

SCALE:2:1 WEIGHT: SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





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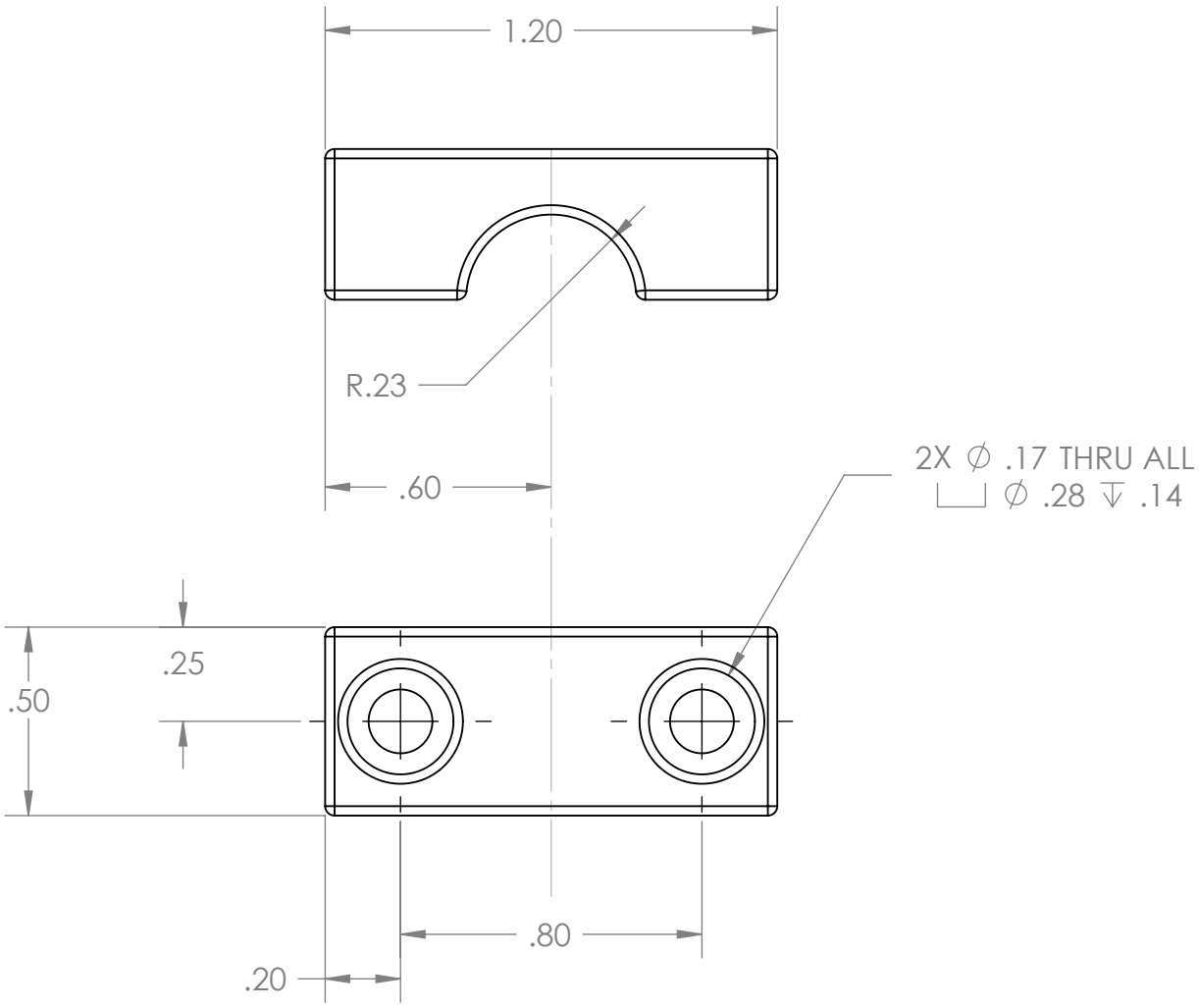
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL	Q.A.		
			COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: Aluminum

EtGly Mixer Holder

SIZE	DWG. NO.	REV.
A	Mixer holder	
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

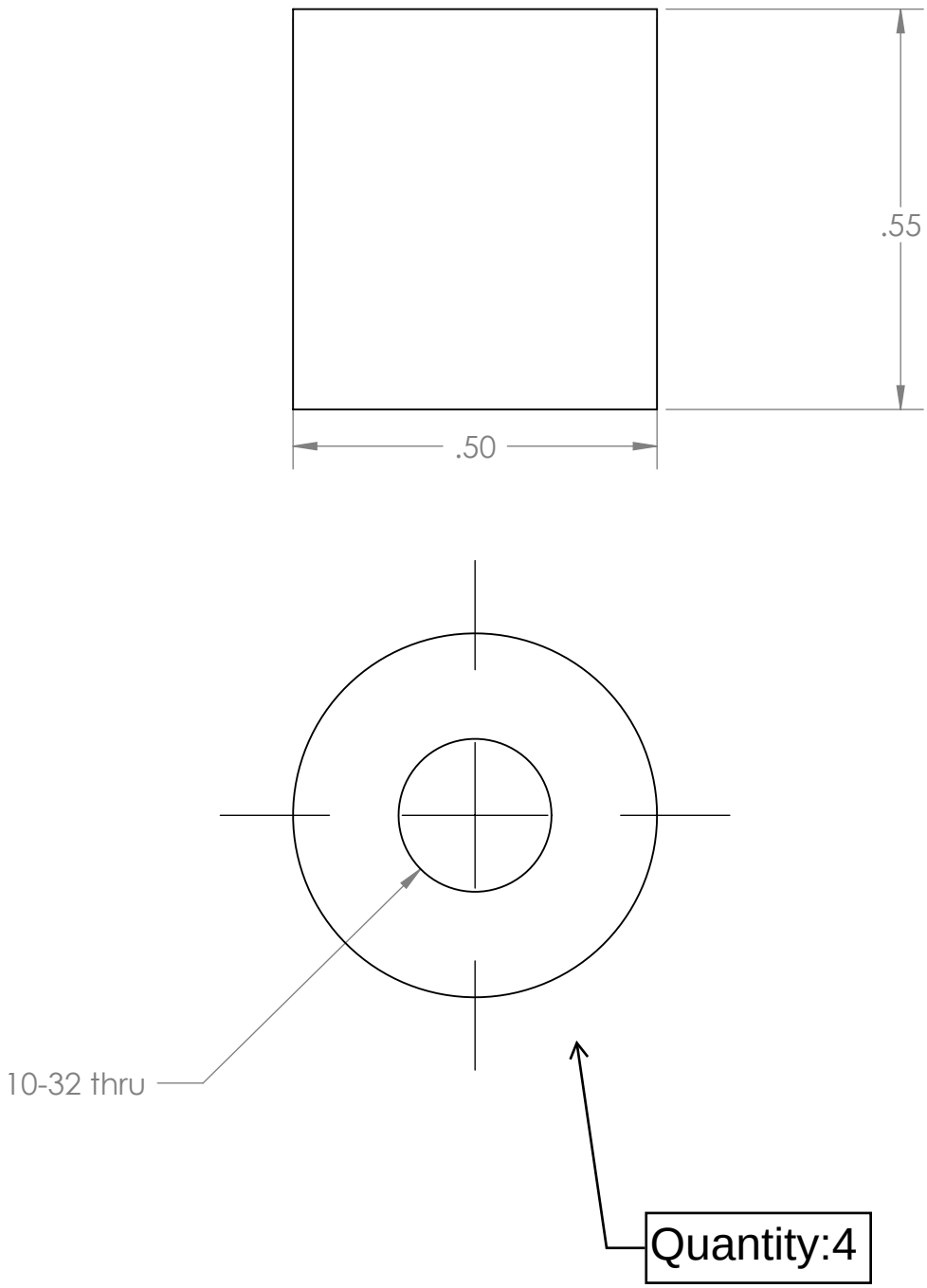


		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

EtGly Mixer Clamp

SIZE	DWG. NO.	REV.
A	mixer clamp	
SCALE:2:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

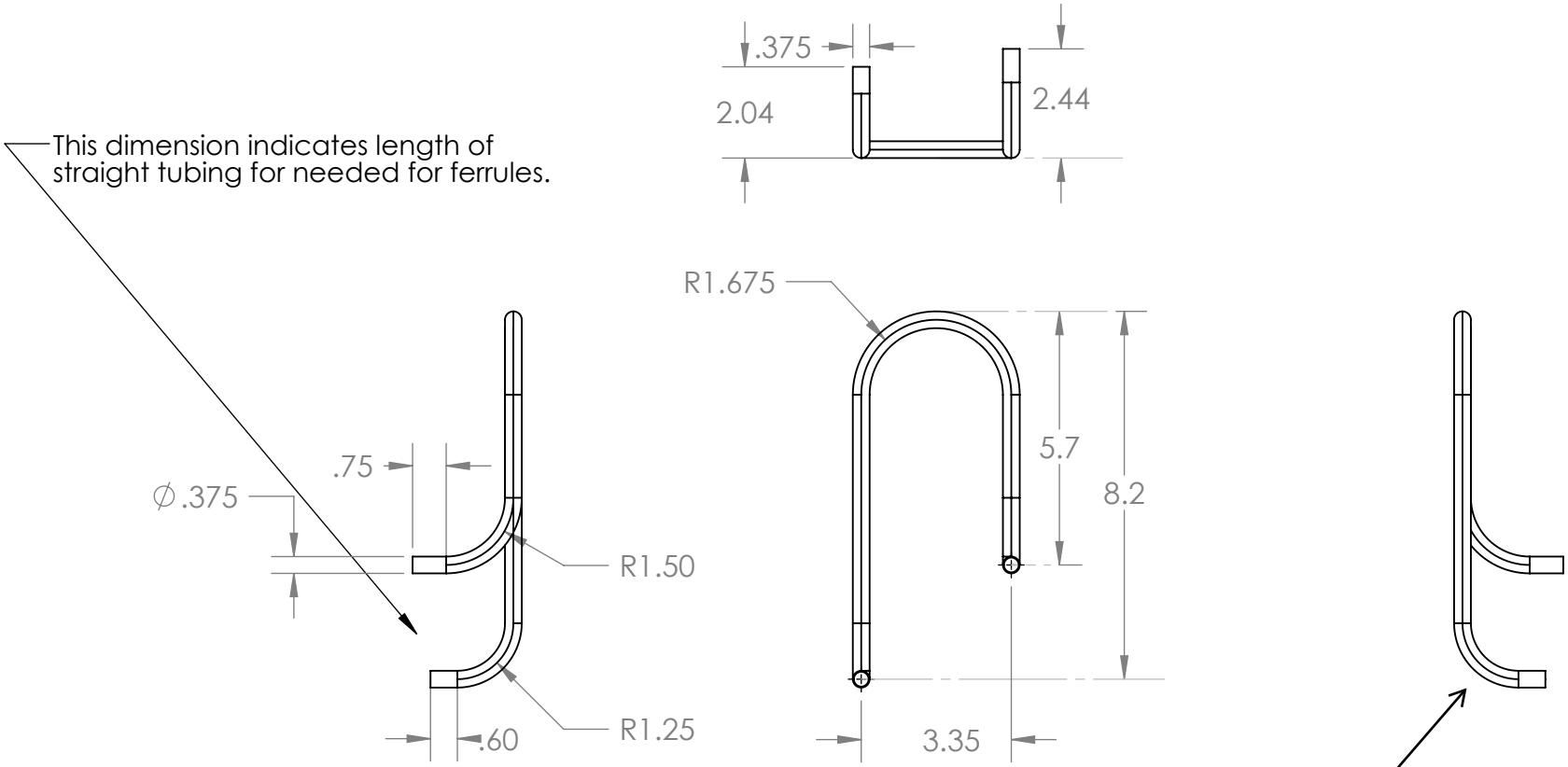


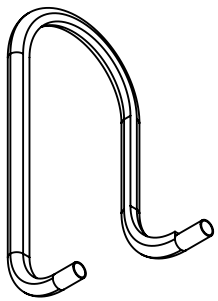
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Plate #2 Standoff

SIZE	DWG. NO.	REV.
A	Spacer_55	
SCALE:4:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

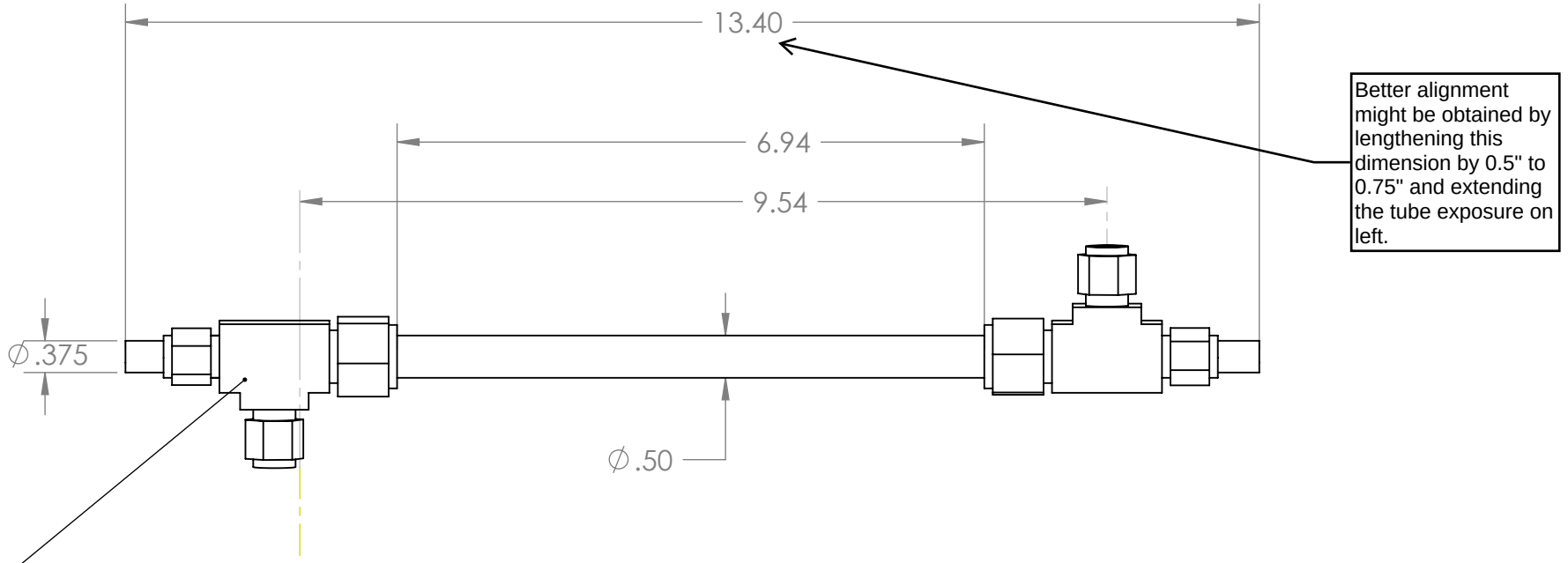
Plate #2 Cooling Tube (JWH: 6-4-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



NOTE: Bore two Swaglock SS-810-3-6-6 fittings thru so that 3/8" dia. tube passes through it unencumbered.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

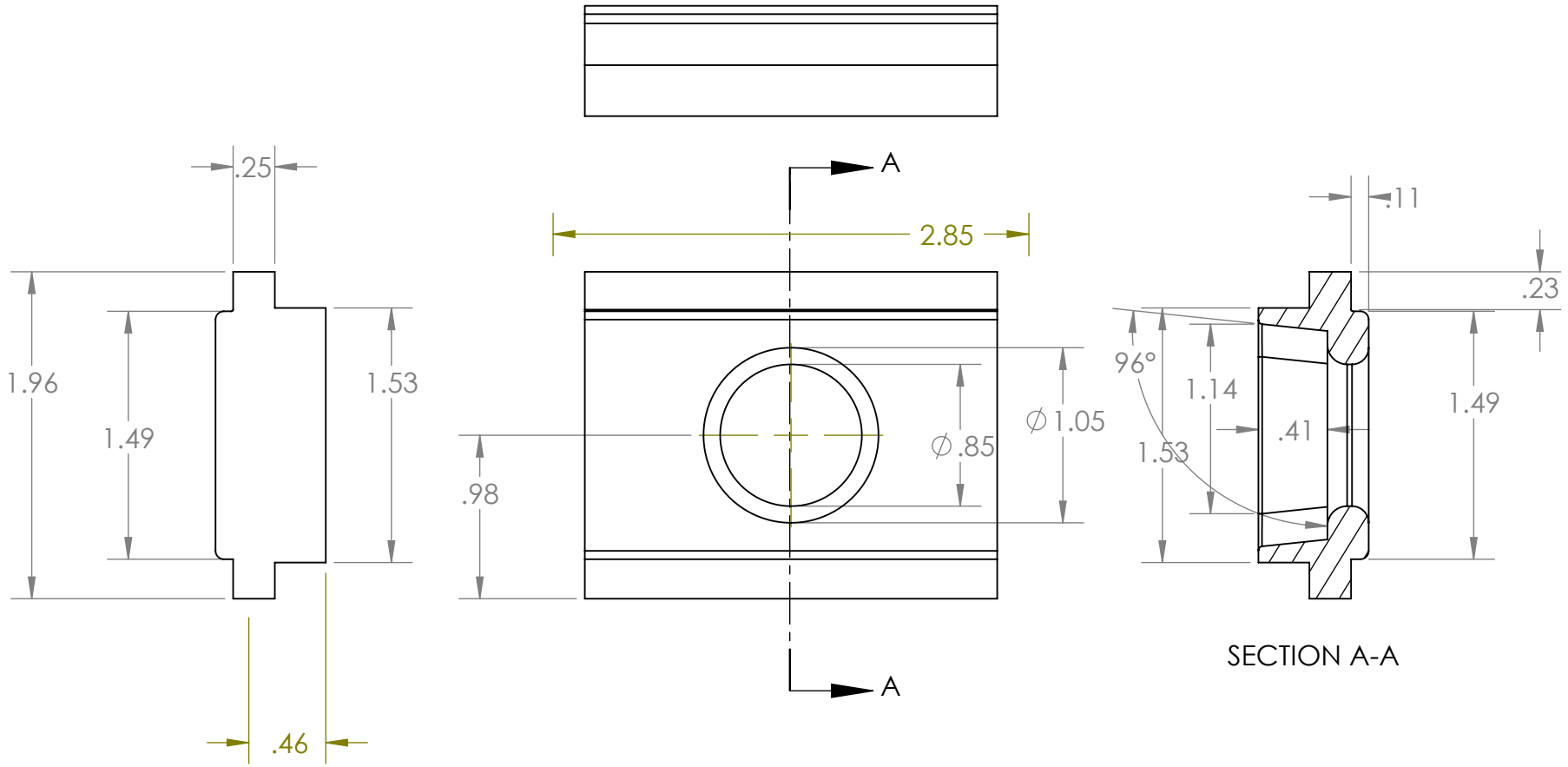
TITLE: Heat Exchanger (JWH: 4-24-2016)

SIZE	DWG. NO.	REV
.A		

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



SECTION A-A

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in AL

TITLE:

Reducing Cell Holder (Page 1 of 2)

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 2

5 4 3 2 1

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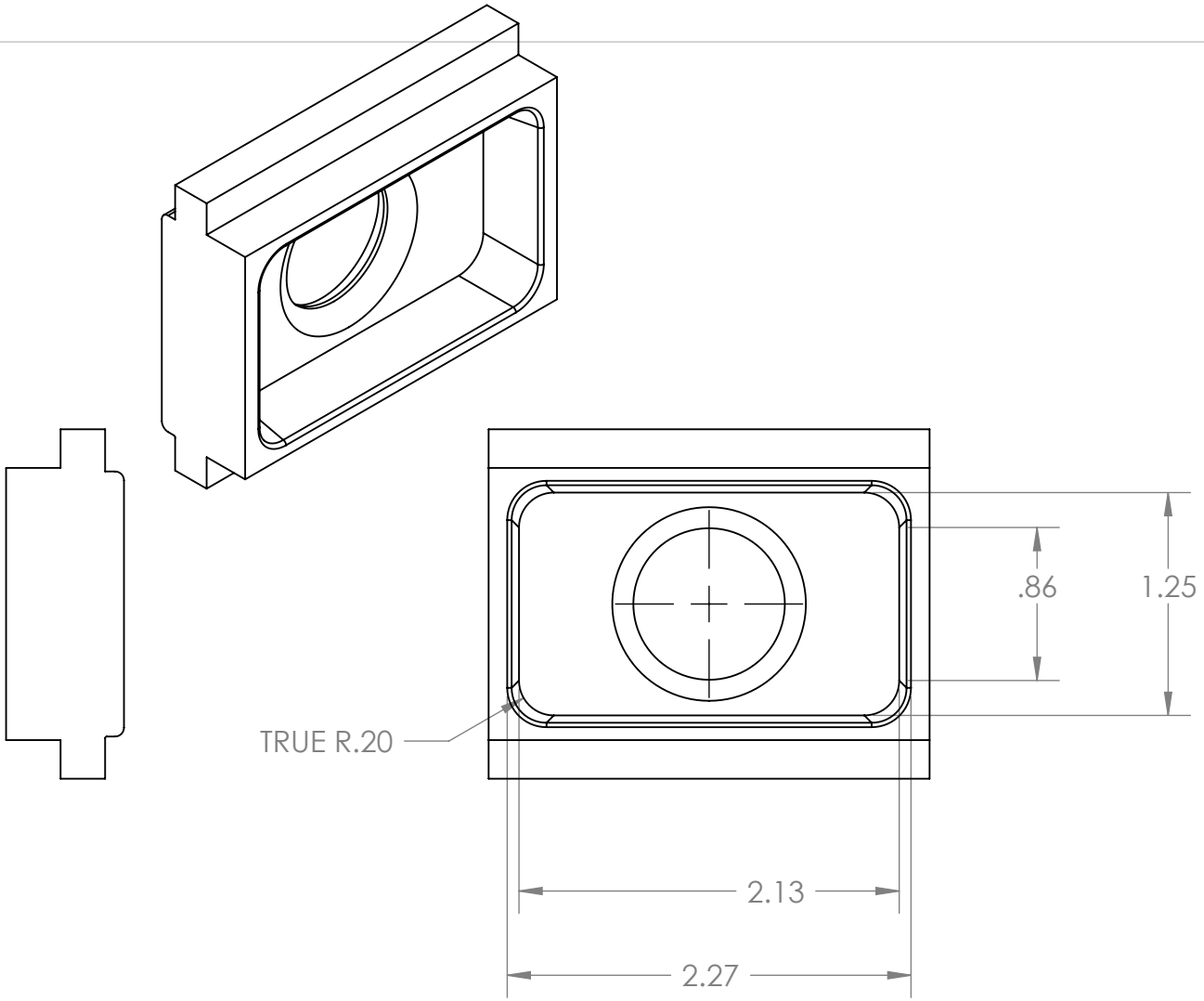


		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Reducing Cell Holder (Page 2 of 2)

SIZE	DWG. NO.	REV
A		

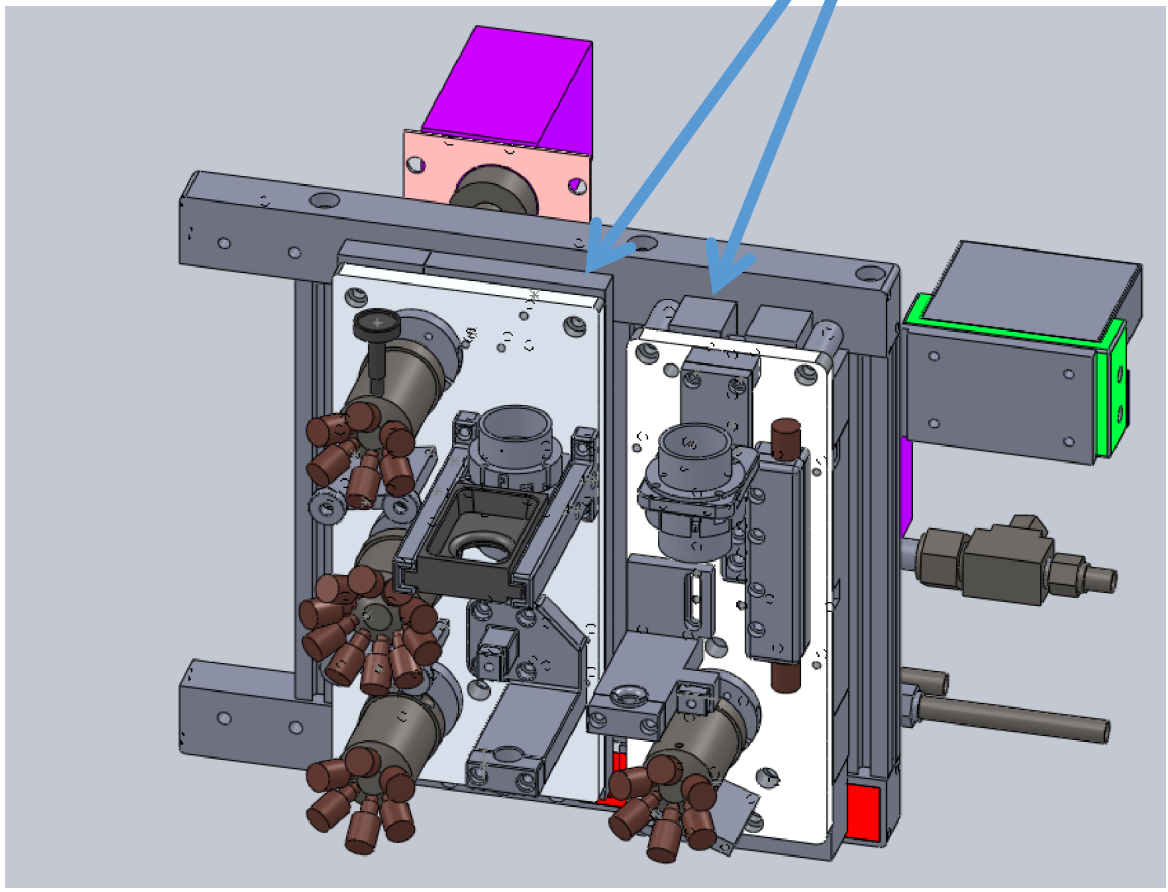
SCALE: 1:1 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Plates 2 & 3 on Frame

Foam Insulation covers back of these plates



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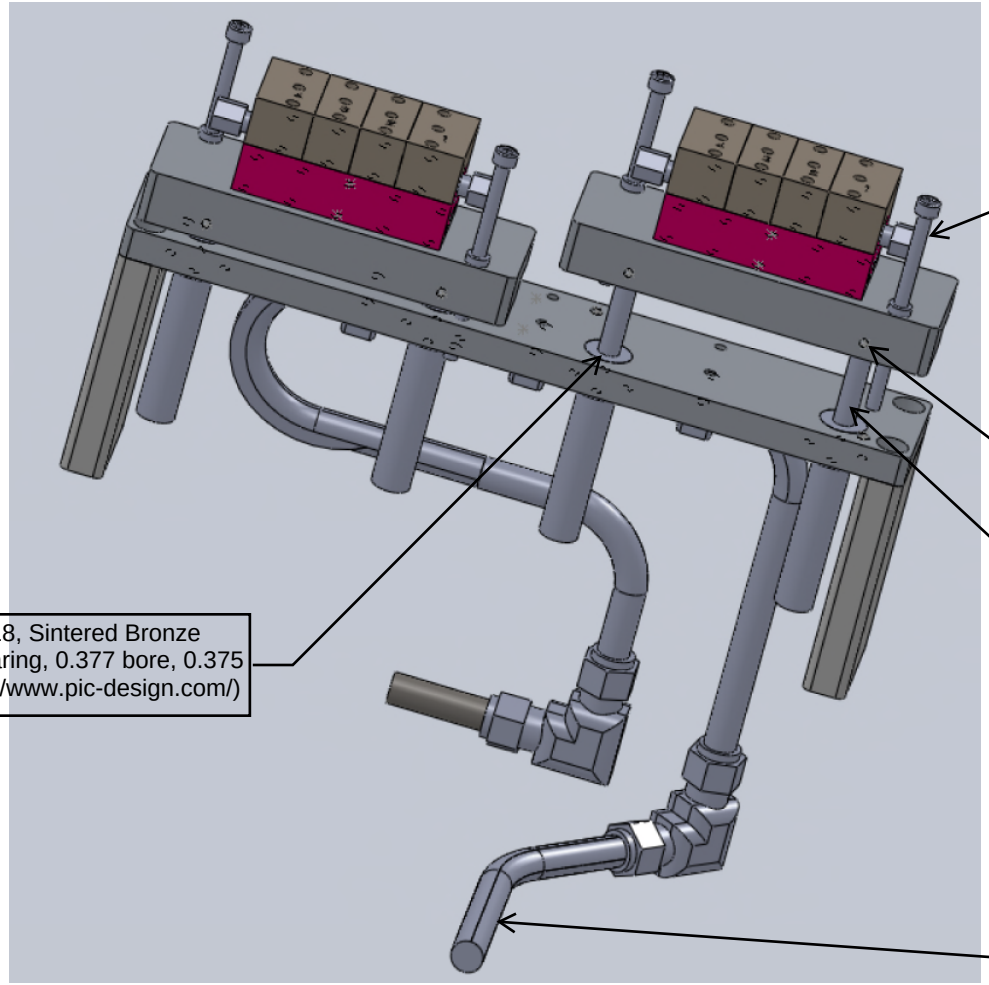
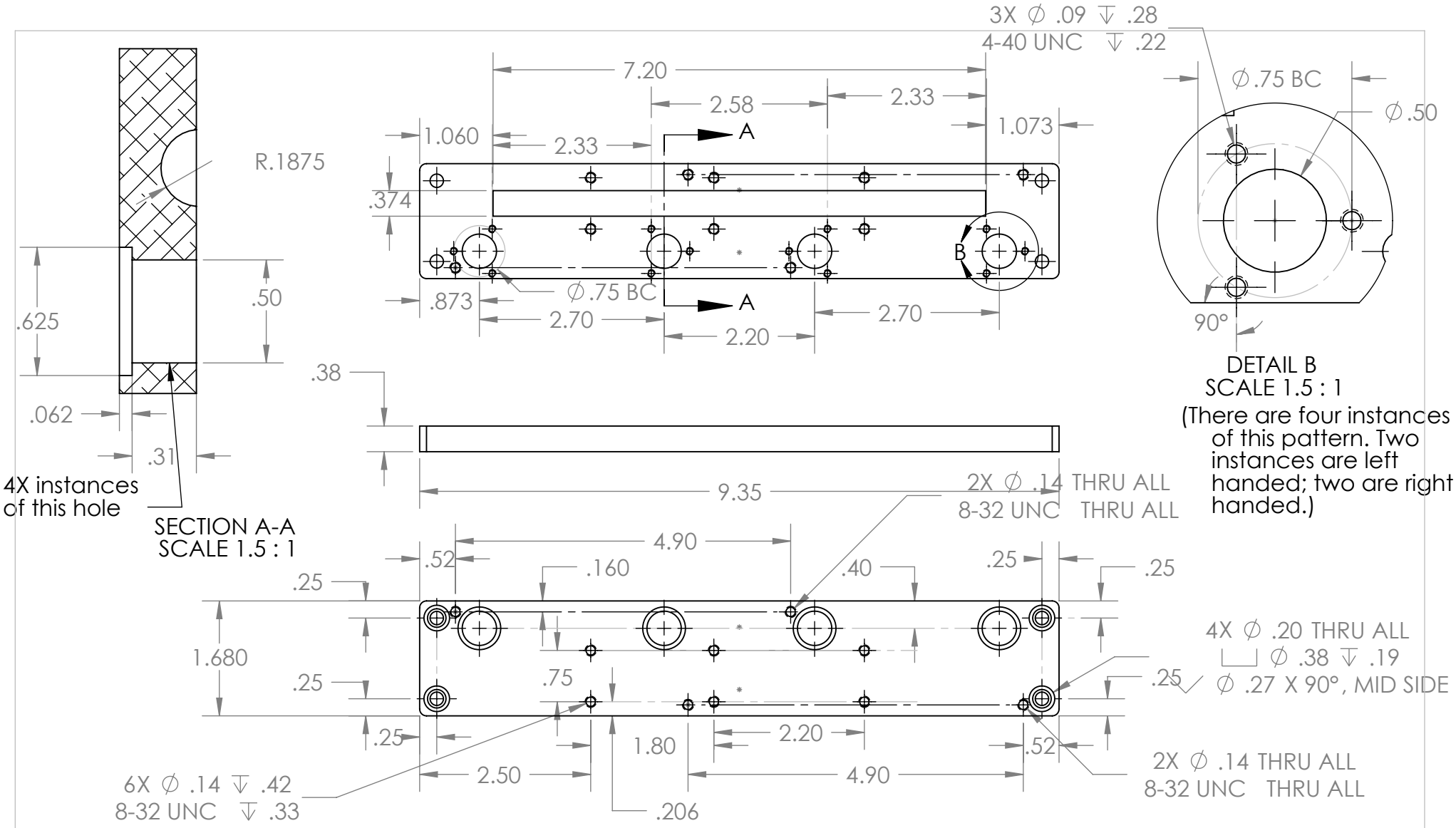
Commercial Parts Incorporated into Protease Stage (Plate #1)



Protease columns on extendable mounts.

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Protease Base Plate

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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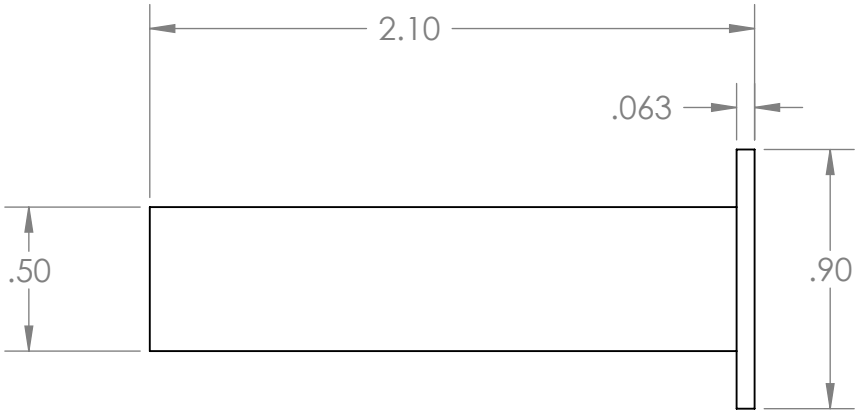
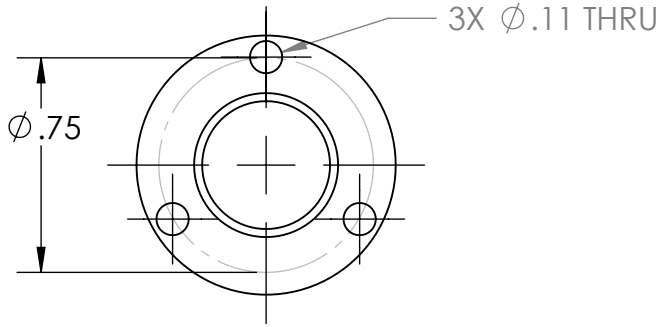
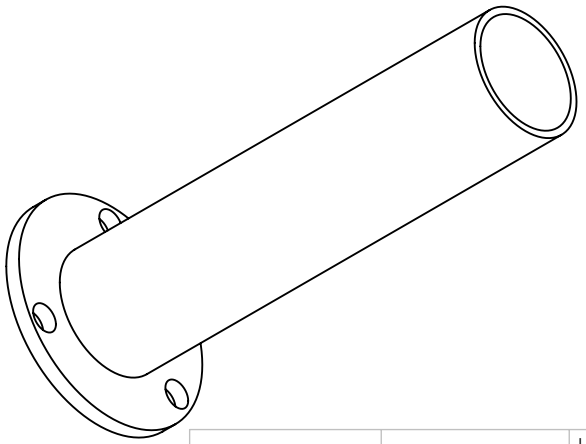






NOTE: These are cheaply and best made by 3D printing in Steel-Bronze using ***"Protease bearing well.STL".***
An IGS file is also included if you wish to go this way.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

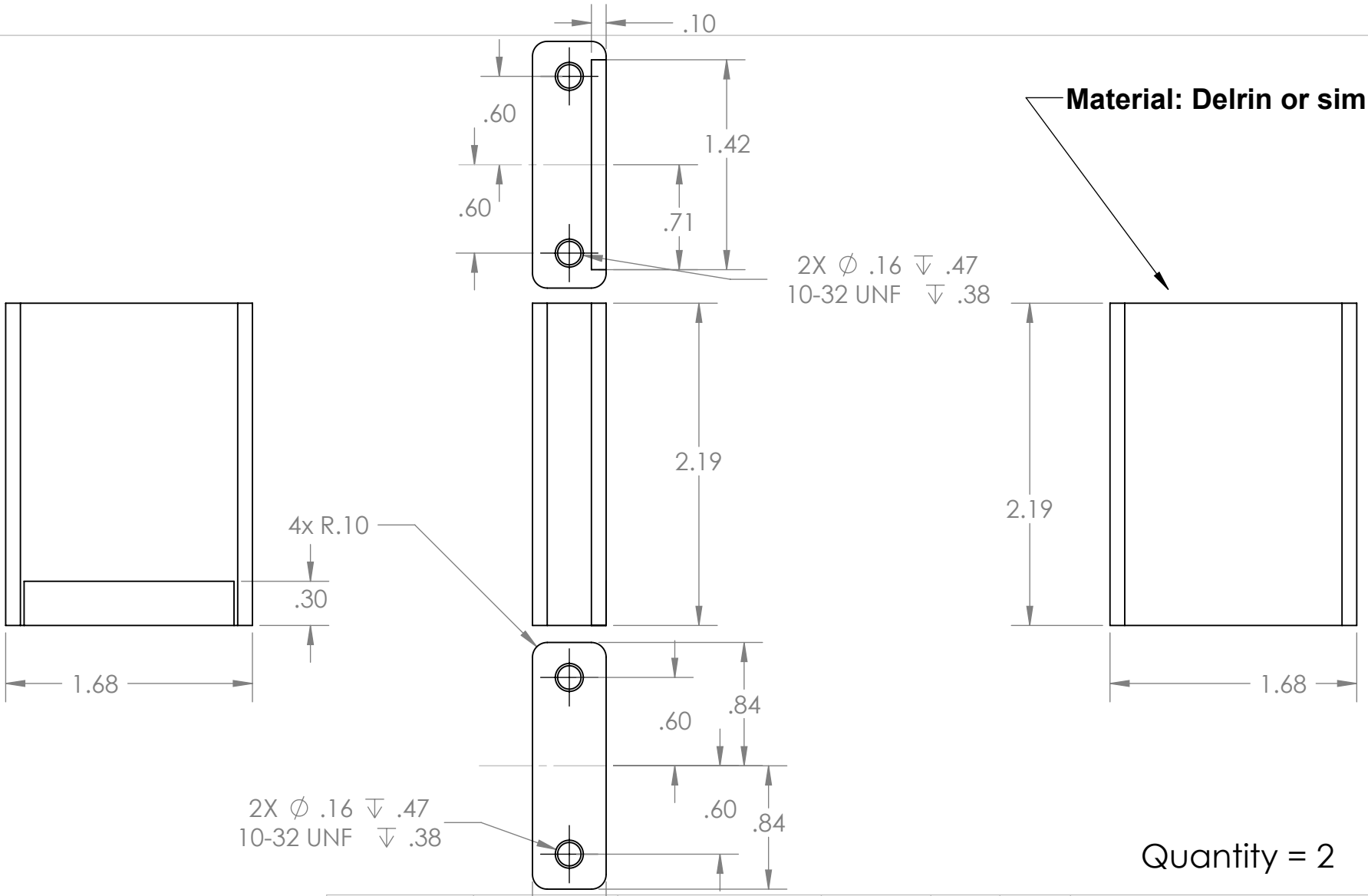
TITLE:
Protease Bearing Well (4-25-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

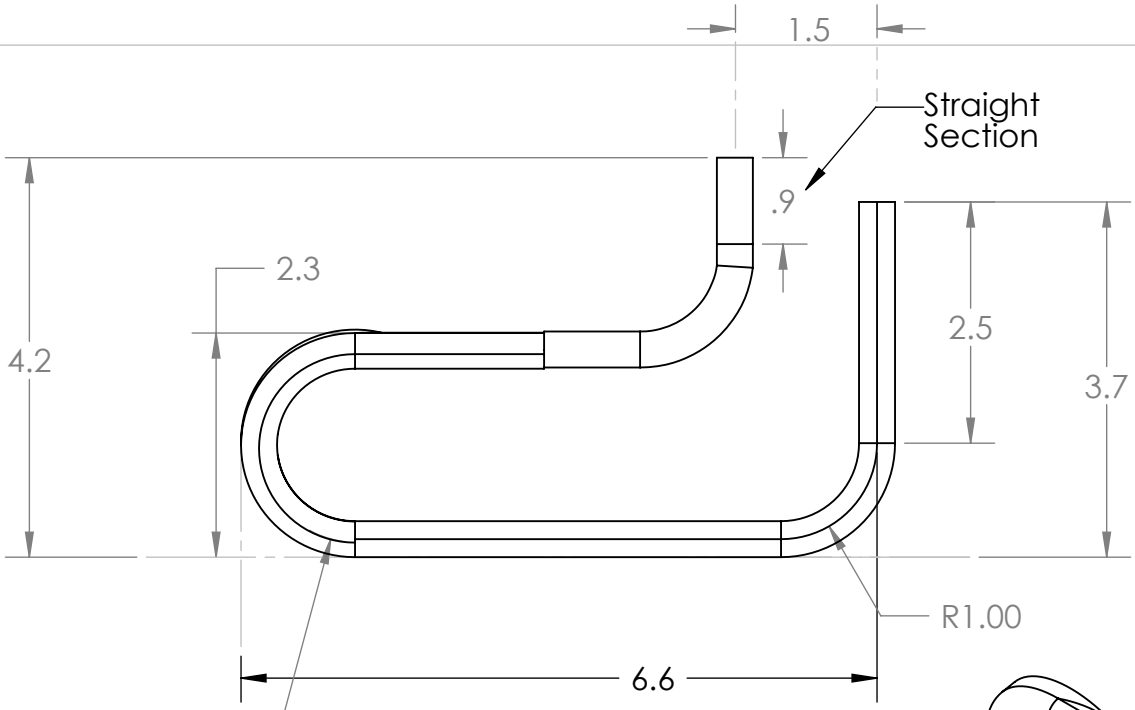


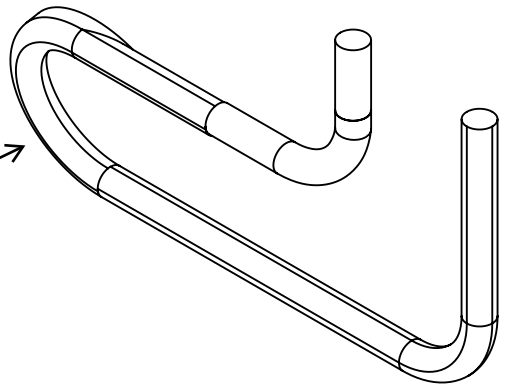
Quantity = 2

			UNLESS OTHERWISE SPECIFIED:		NAME DATE
			DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN CHECKED ENG APPR. MFG APPR. Q.A.	TITLE: Enzyme Reactor Standoff II 6-30-2016
			INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:	
			MATERIAL		SIZE A · DWG. NO. · REV
NEXT ASSY	USED ON		FINISH		
APPLICATION			DO NOT SCALE DRAWING		SCALE: 1:1 WEIGHT: SHEET 2 OF 2

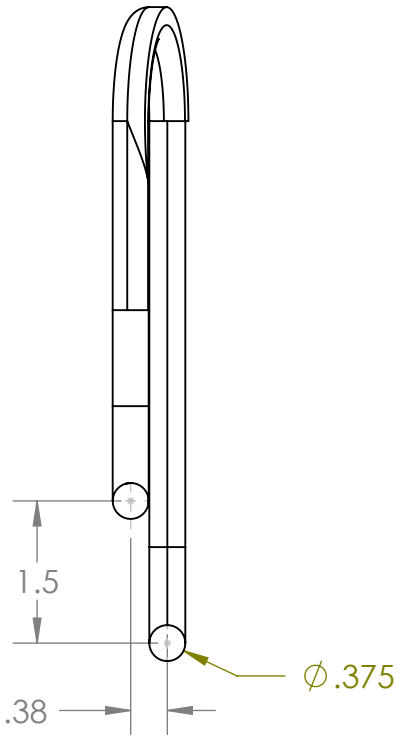
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





In spite of appearances, this is 316/316L seamless stainless steel tube 3/8"x 0035" wall.



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Proteolytic Cooling Coil (JWHL 6-4-2016)

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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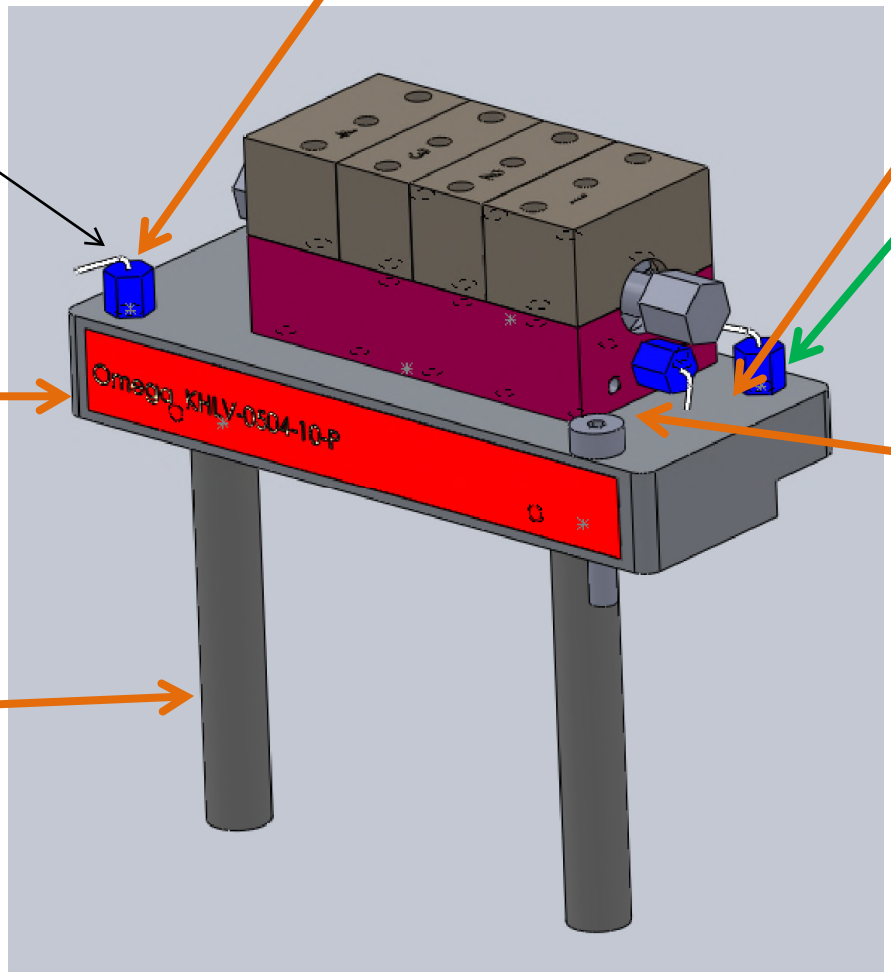
Details of Protease Stage Assembly

Model ON-950-44004, Bolt Mount Thermistor Sensor (Omega Engineering)

Thermistors can be mounted in 3 positions. We mounted on stage itself (green arrow).

Kapton heat tape Applied on side and a smaller tape on shelf under stage

Precision ground shafts that are held by bearings.



Apply silver-based heat conductive paste between stage And lower clamp to improve heat conduction

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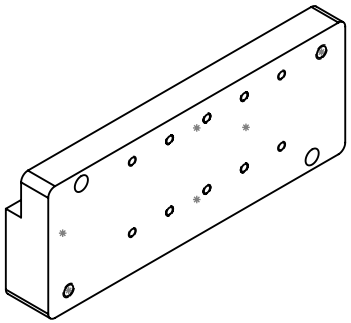

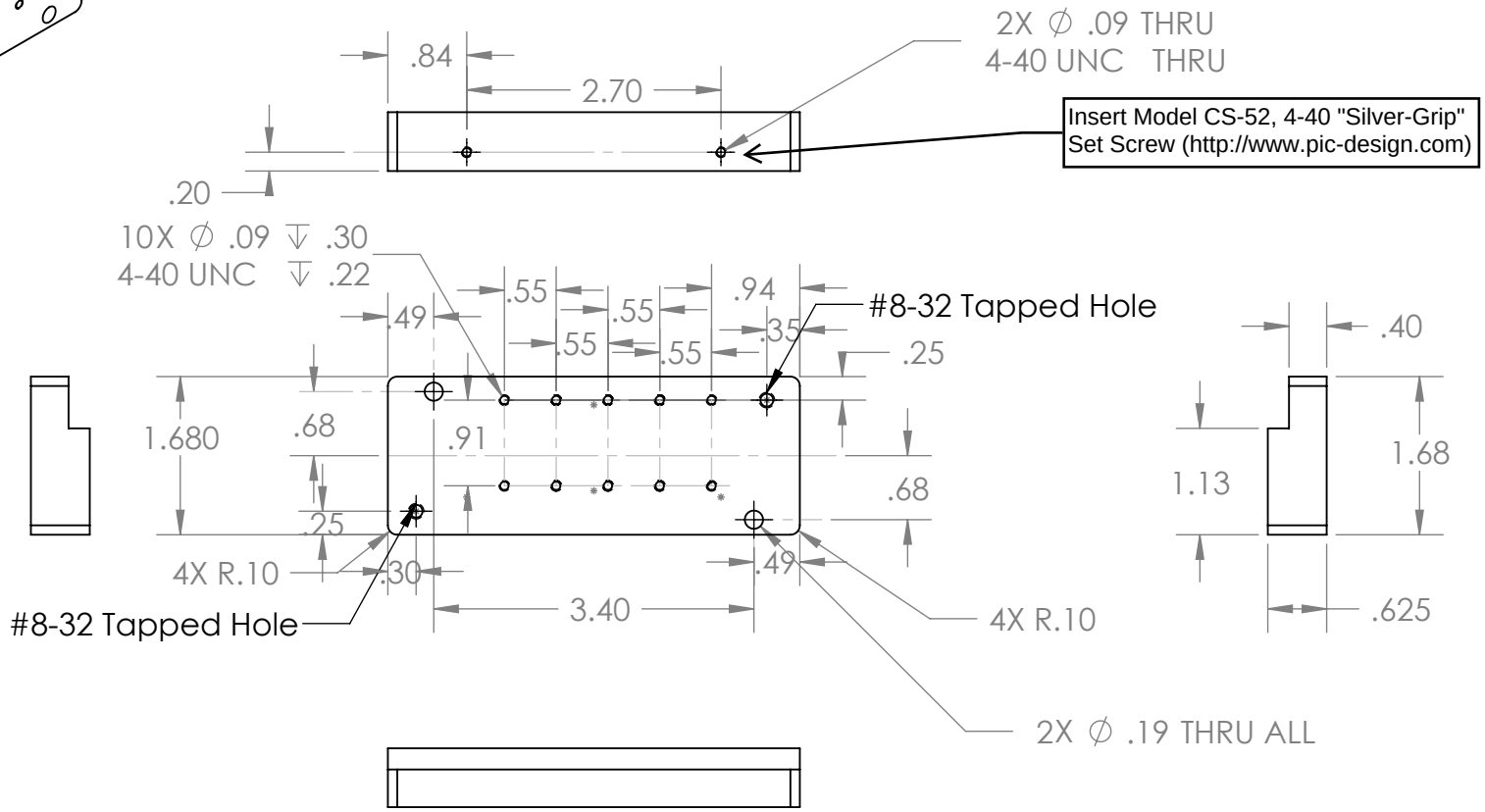

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 Aluminum

TITLE:
Enzyme Sole Plate
(4-10-1016)
page 1 of 2

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

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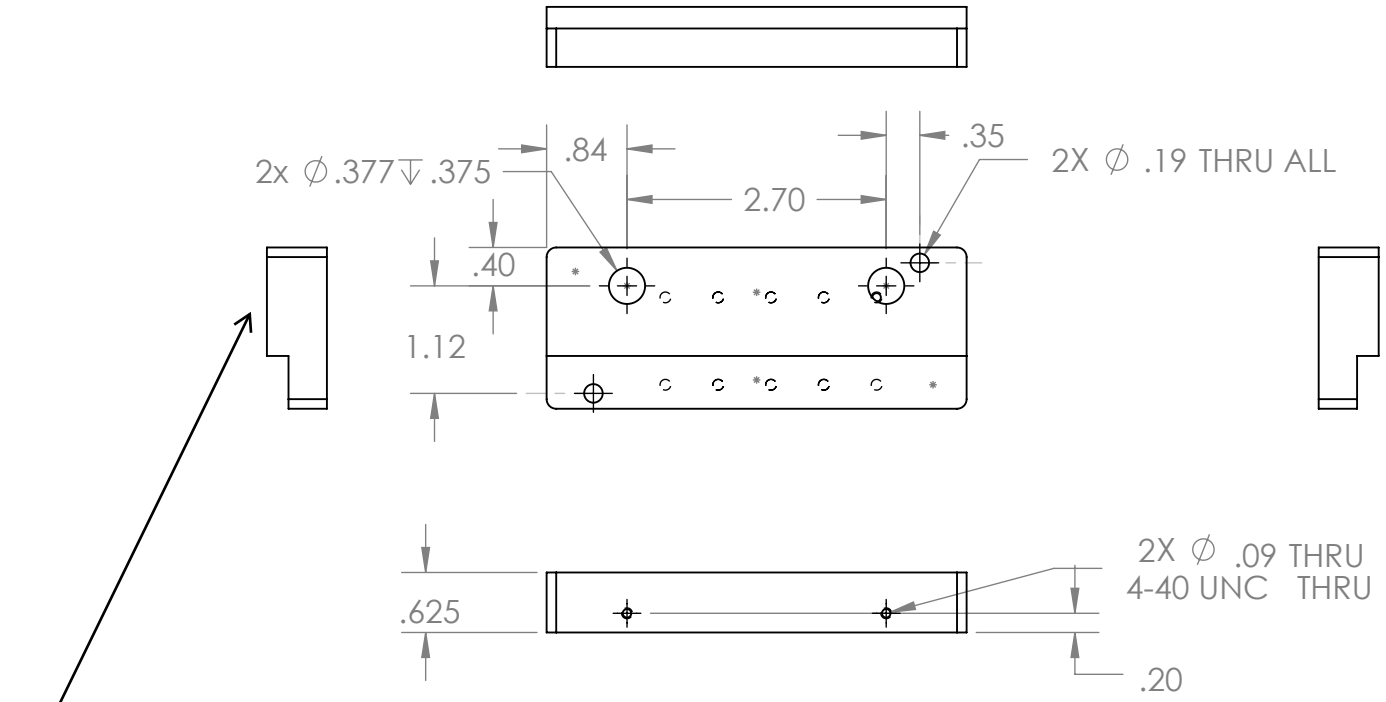

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
		MATERIAL			
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: Enzyme Sole Plate p 2/2

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

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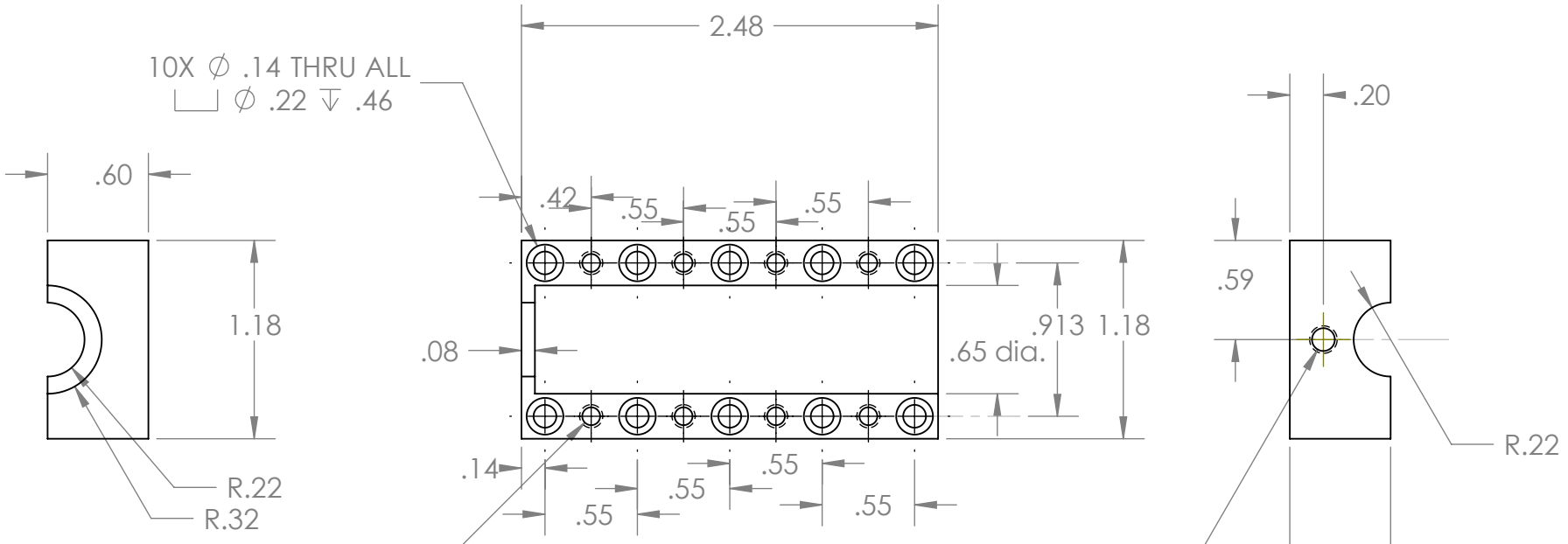

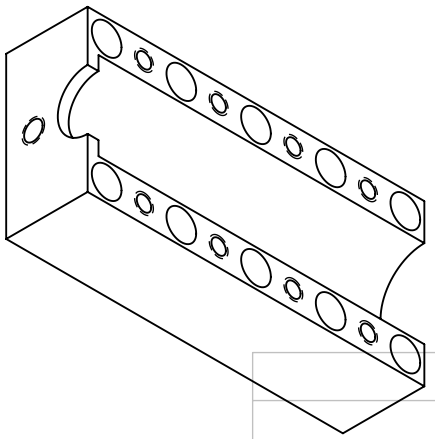

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:
Protease Column
BottomClamp

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 2

5 4 3 2 1

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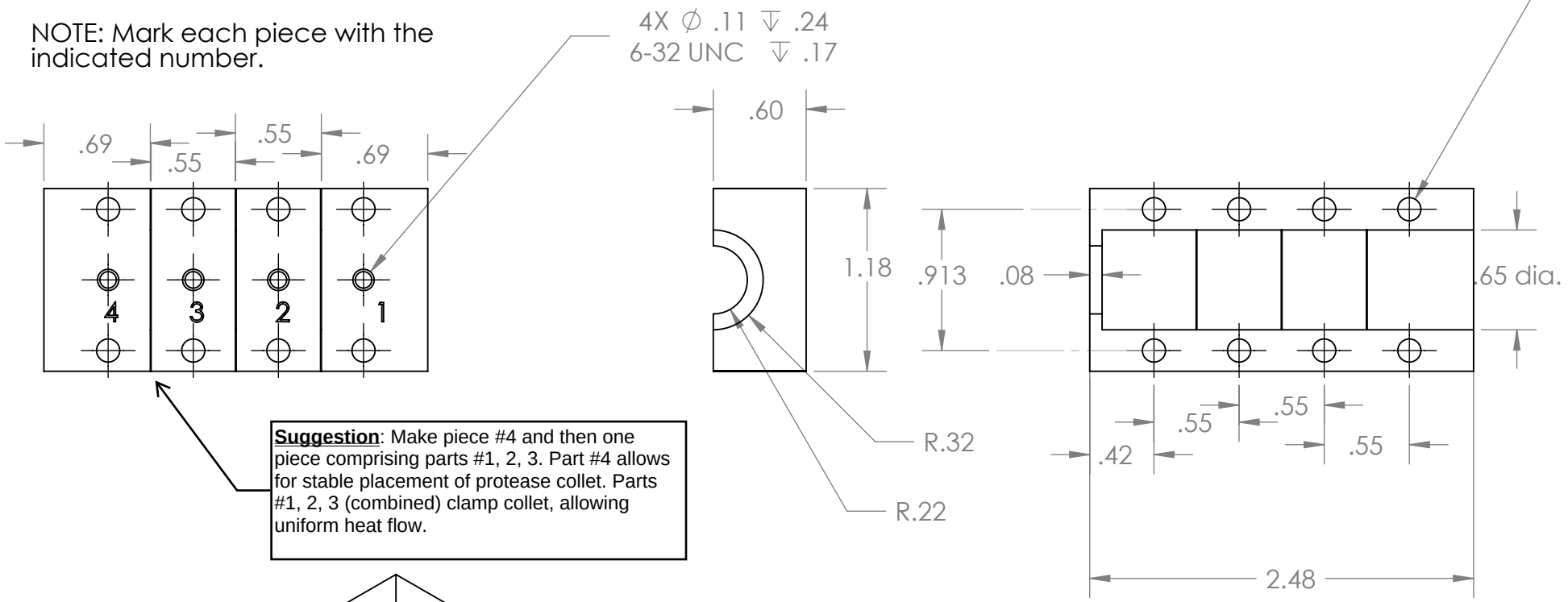
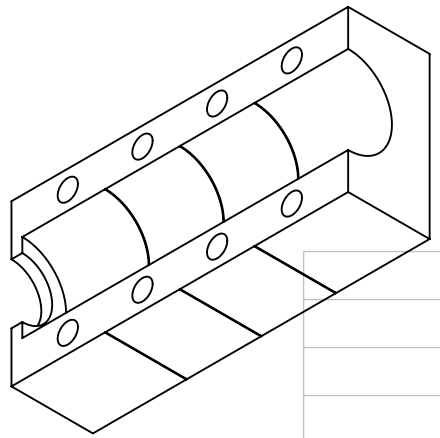
NOTE: At each mark cut with thin saw so that the final product is four numbered pieces.

Method described here is obsolete. Direct machining can produce required pieces.

NOTE: Mark each piece with the indicated number.



Suggestion: Make piece #4 and then one piece comprising parts #1, 2, 3. Part #4 allows for stable placement of protease collet. Parts #1, 2, 3 (combined) clamp collet, allowing uniform heat flow.



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE: Top Clamp Assembly for Protease Column

SIZE	DWG. NO.	REV
A		

SCALE: 1:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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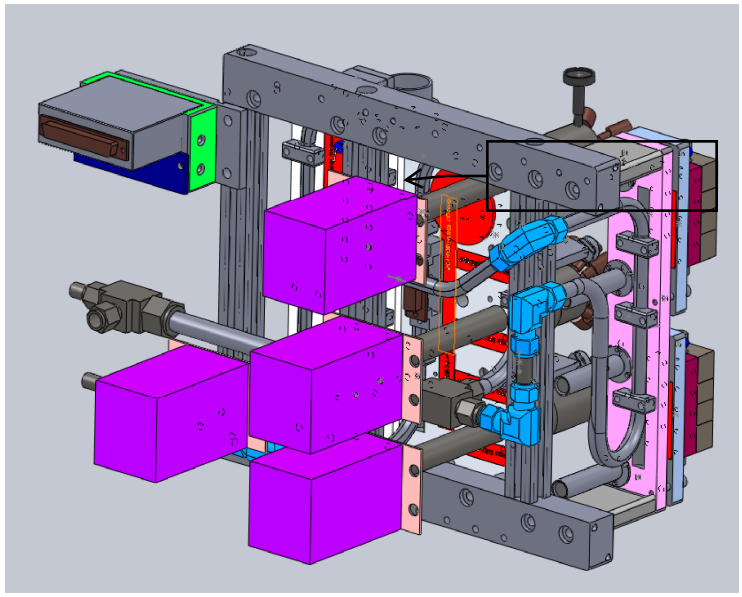
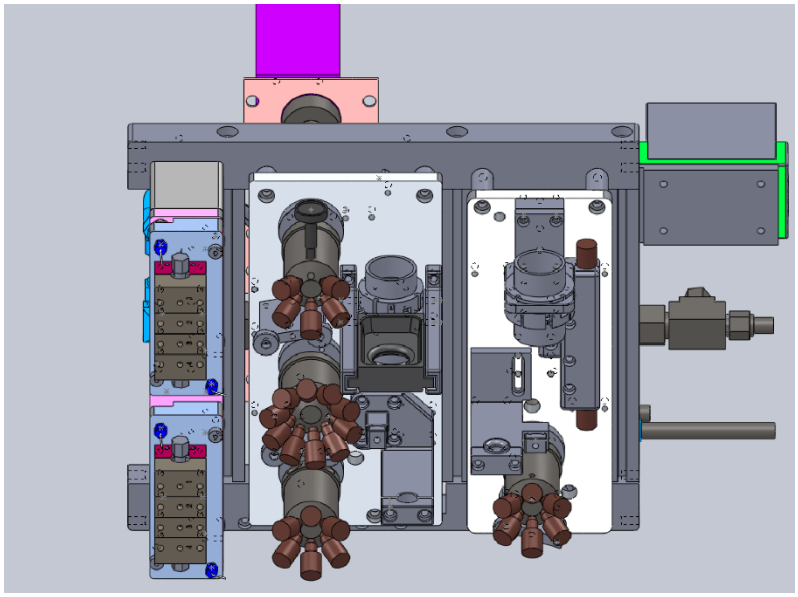
Assembly View of Frame + 3 Plates





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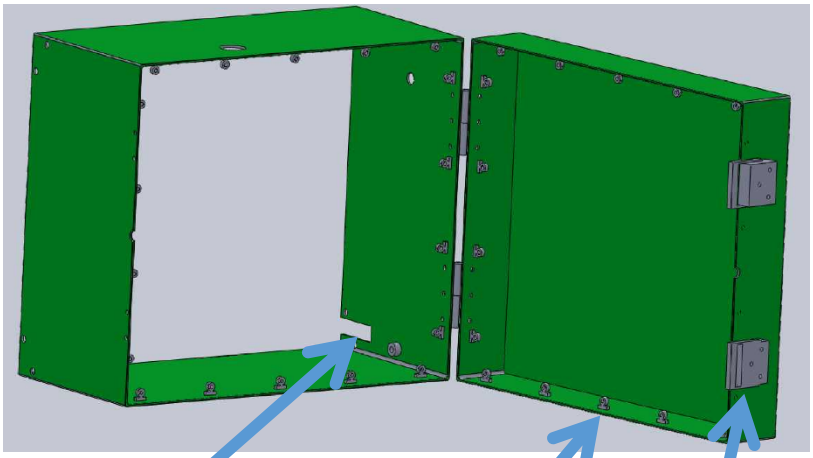
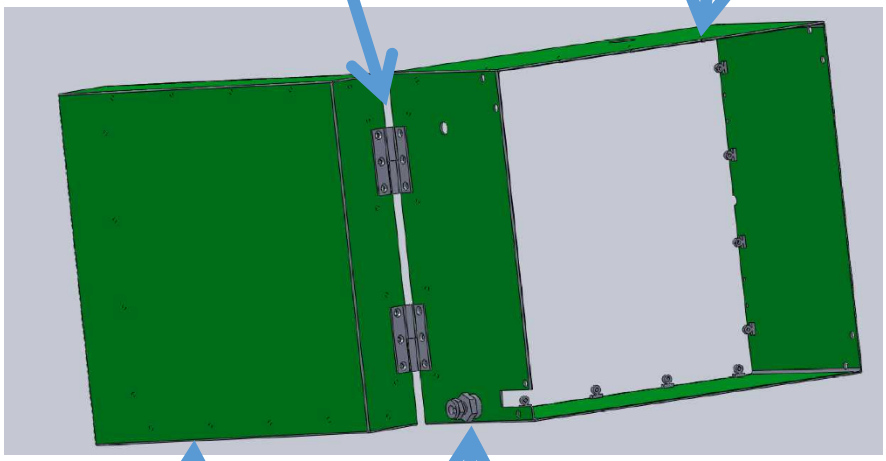
Overview of Shell Enclosure





Model 4WDX4, LIFT-OFF HINGE, POLISHED, 1.97 X 1.26 IN, Left (http://www.theofficestore.com)

Back Shell

Capillary Entrance Slot

6-32 Anchor Nut (Press fitted into shell)

Latch

Grainger part# 5CRV4, Draw Latch, Release to Open, Draw to Close

Front Shell

Dry Purge Gas Entry Connector Swagelock SS-400-1-2-OR

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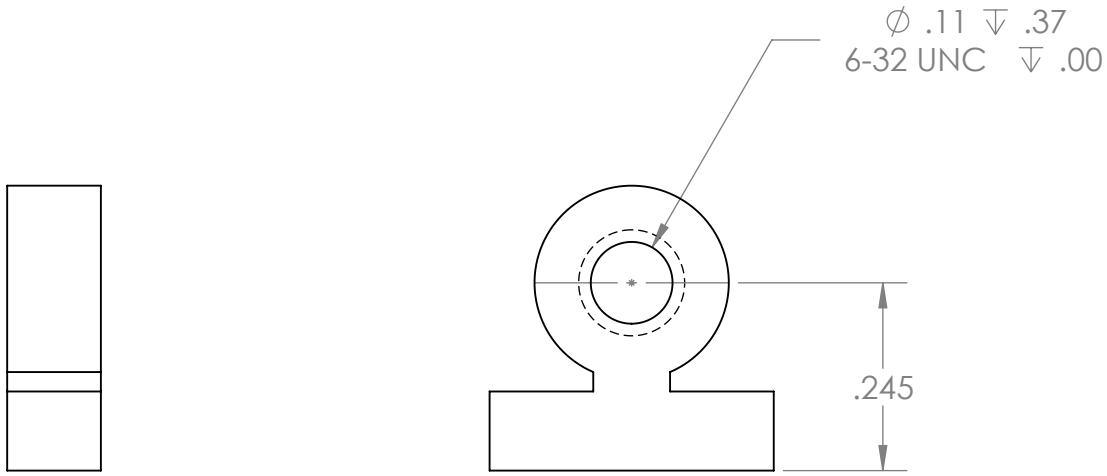
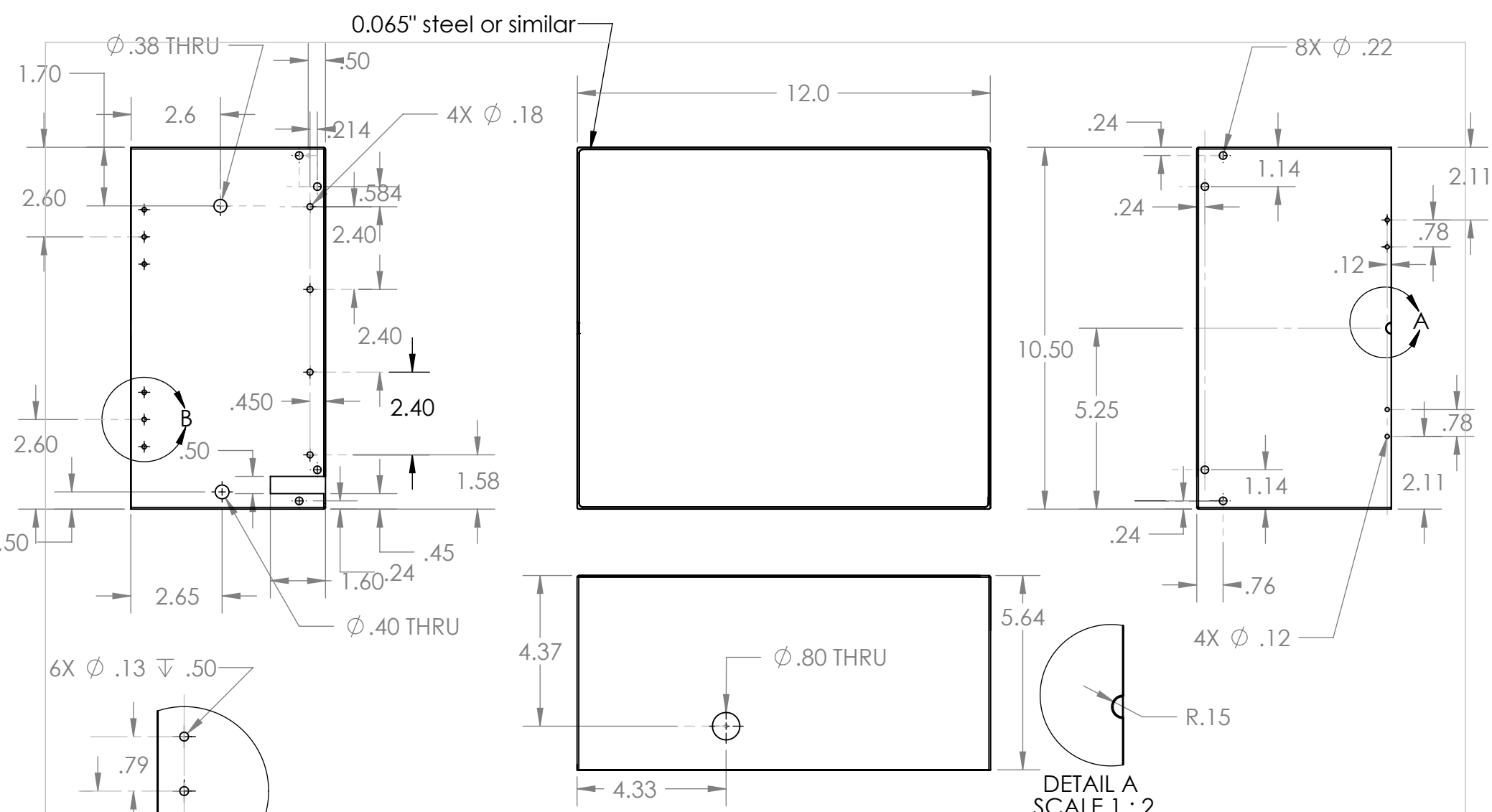


These anchor nuts are available comercially.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE	
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN			TITLE: Anchor Nut
			CHECKED			
			ENG APPR.			
			MFG APPR.			
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
		MATERIAL	COMMENTS:			SIZE A DWG. NO. Anchor Nut REV
NEXT ASSY	USED ON	FINISH				
APPLICATION		DO NOT SCALE DRAWING				SCALE: 4:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Customer will send clamps and hinges before job begins.

TITLE:

Box (part 1)
JWH: 4-25-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

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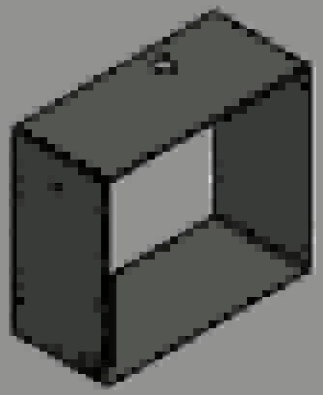

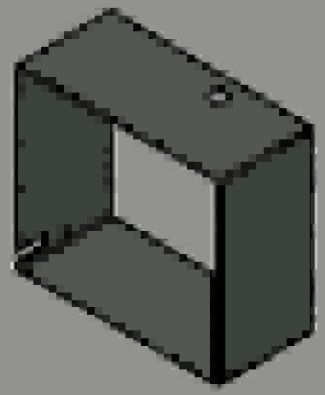

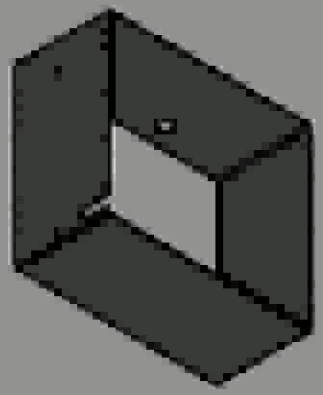

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: Box (part 1)
JWH: 3-30-2016)

SIZE A | DWG. NO. Shell-backless | REV

SCALE: 1:4 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

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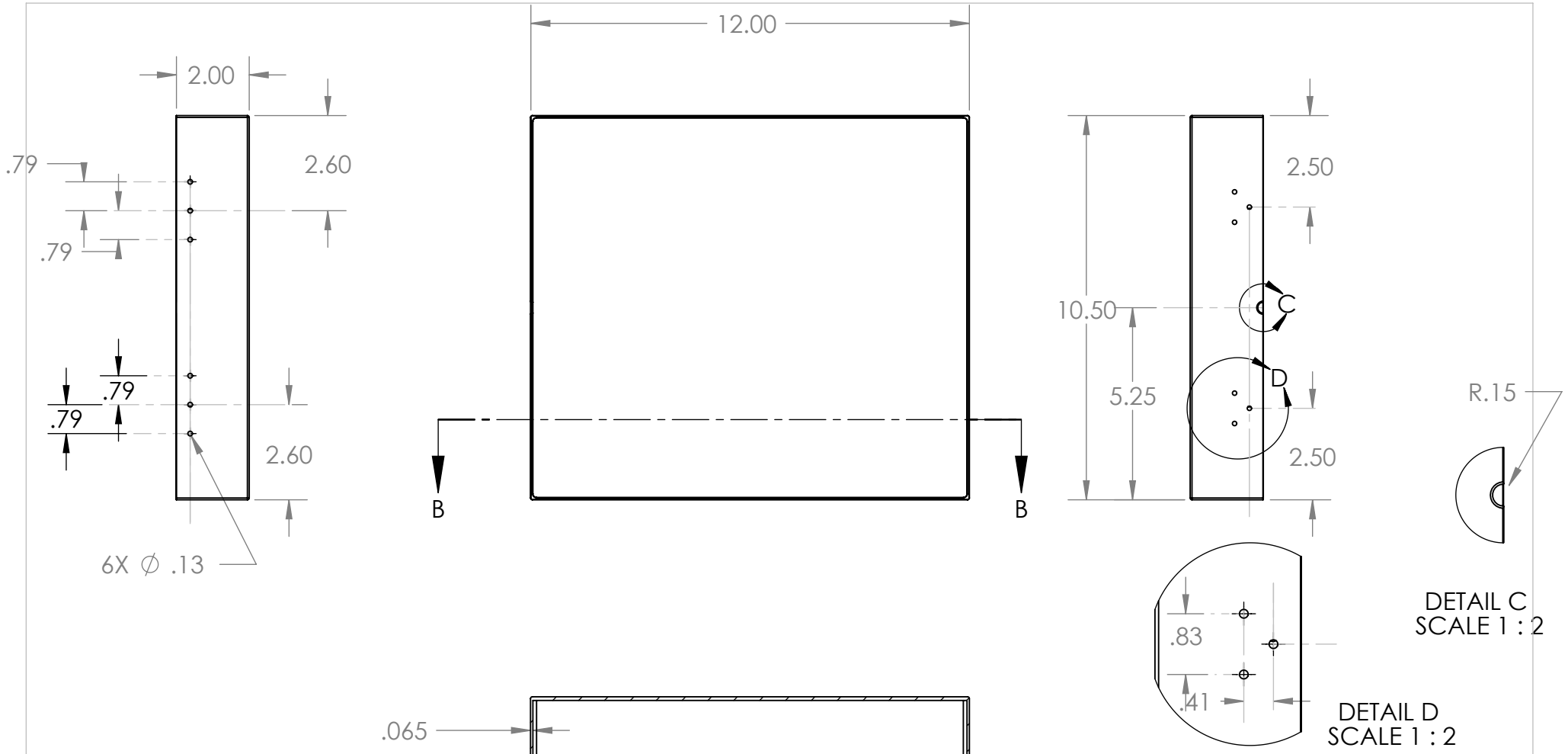


DETAIL C
SCALE 1 : 2

DETAIL D
SCALE 1 : 2

SECTION B-B

Steel sheet of similar thinkness is OK too.

NOTE: Before job begins, customer will deliver latches and hinges.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

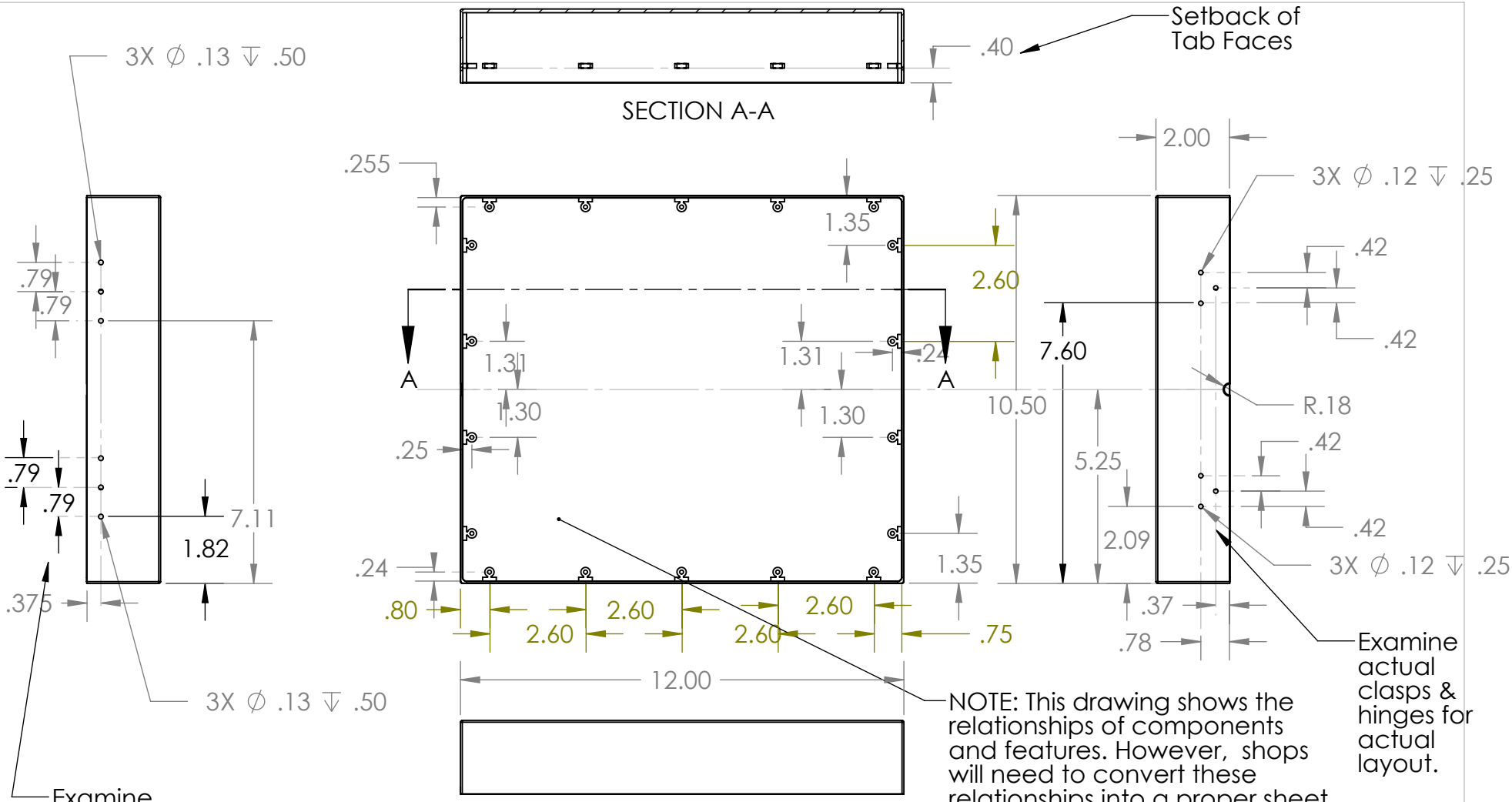
Front Door
4-25-2016

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Assembly of

TITLE:

HPLC Box Door (JWH: 4-3-2016)

SIZE	DWG. NO.	REV
A	.	

SCALE: 1:4 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

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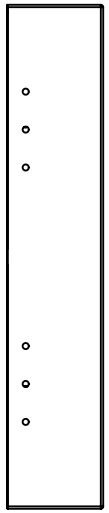
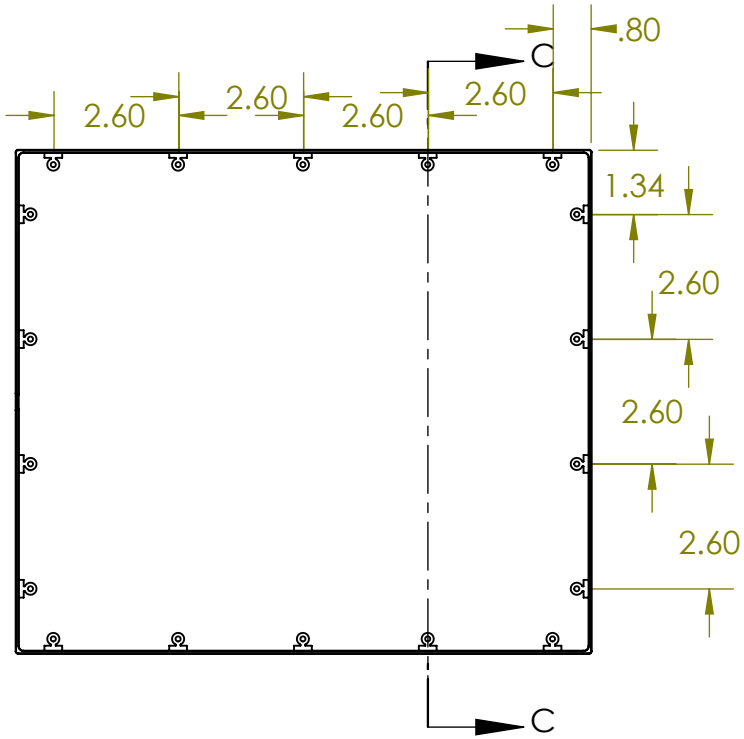
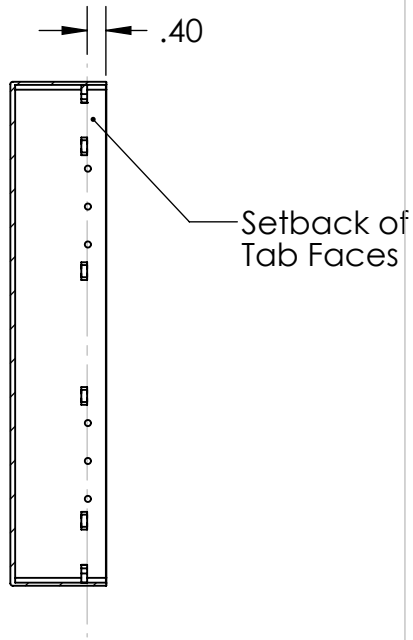
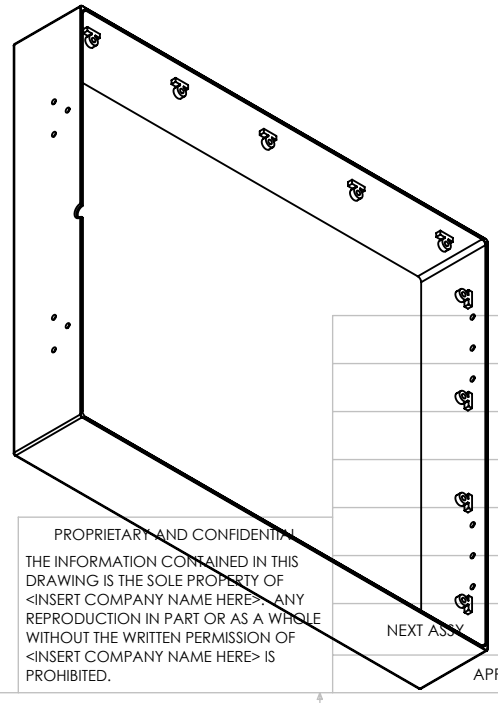






SECTION C-C



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: HPLC Box Door (JWH: 4-3-2016)

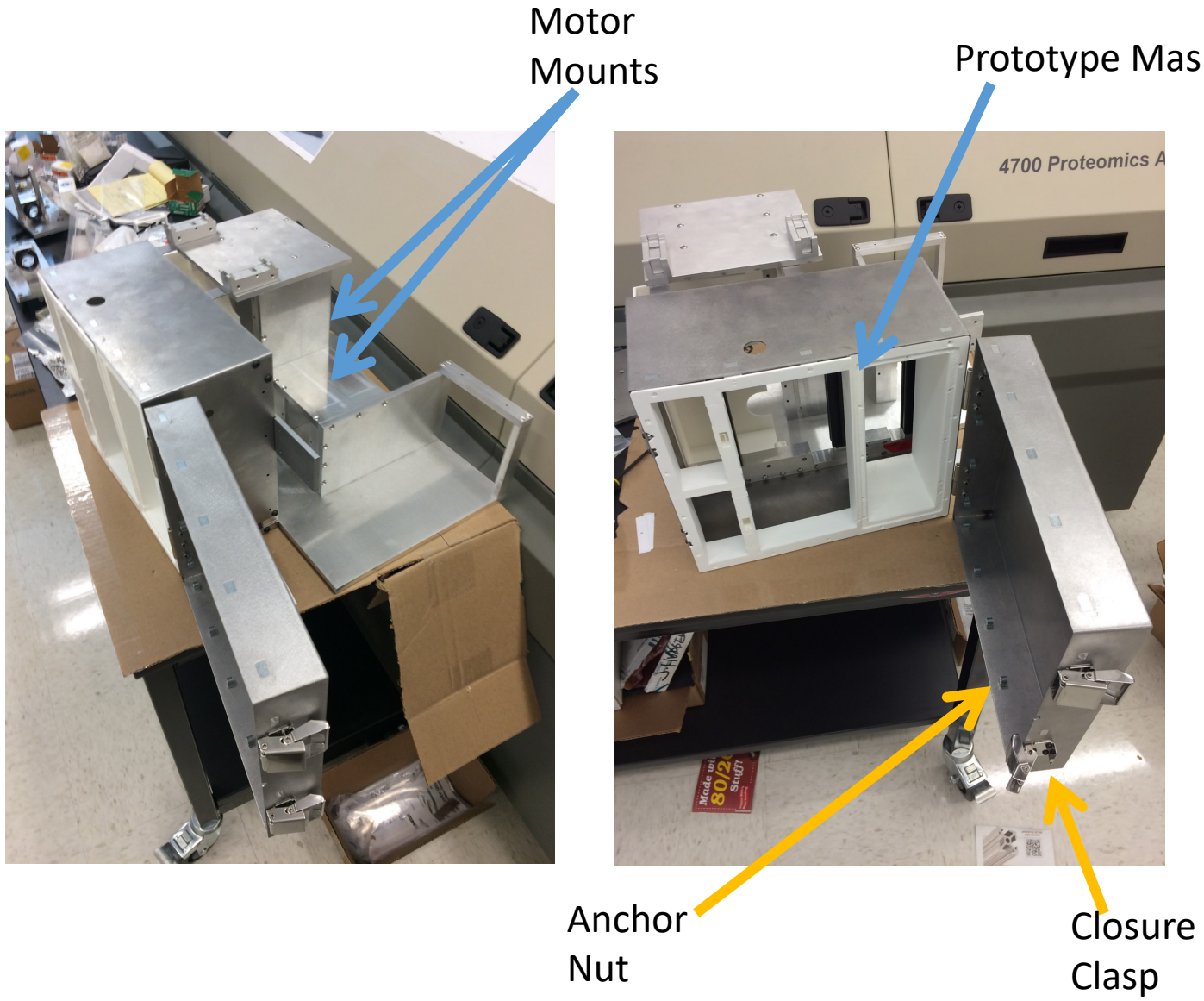
SIZE	DWG. NO.	REV
A	.	

SCALE: 1:4 WEIGHT: SHEET 2 OF 2

5 4 3 2

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Box Assembly (Before Surface Treatments)



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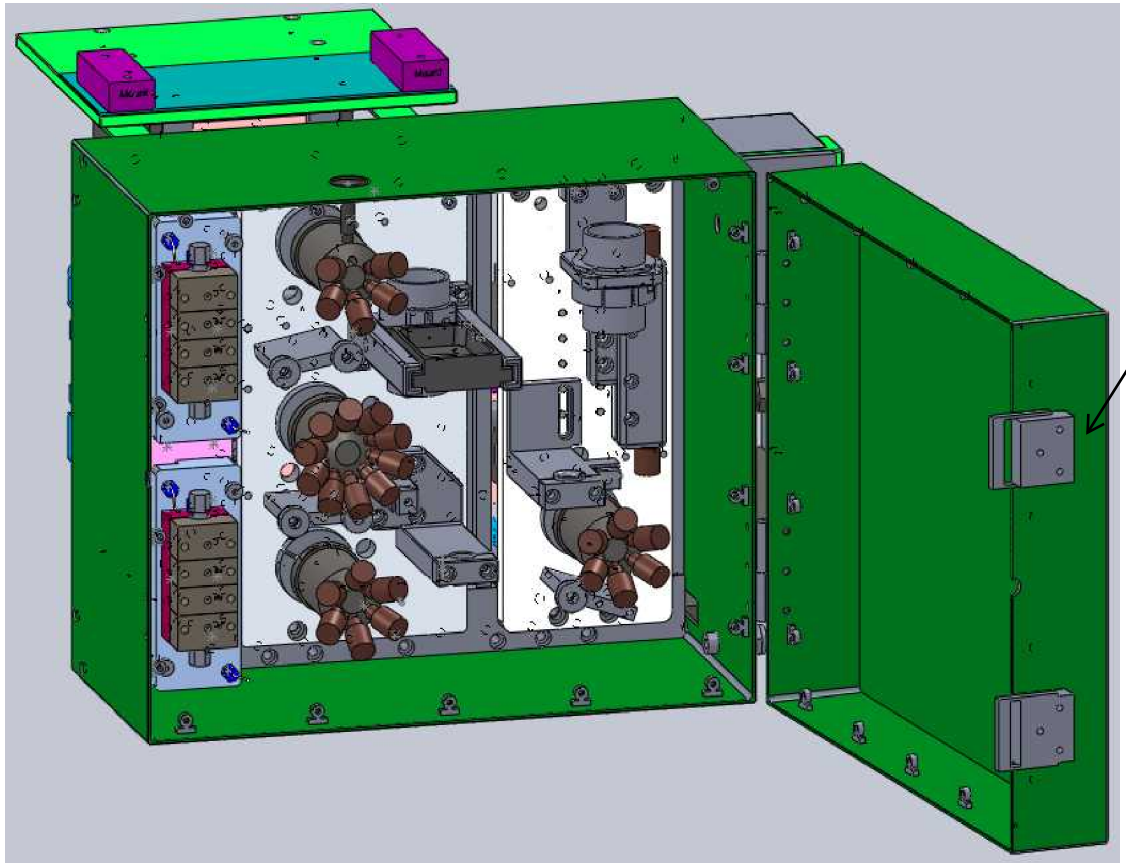
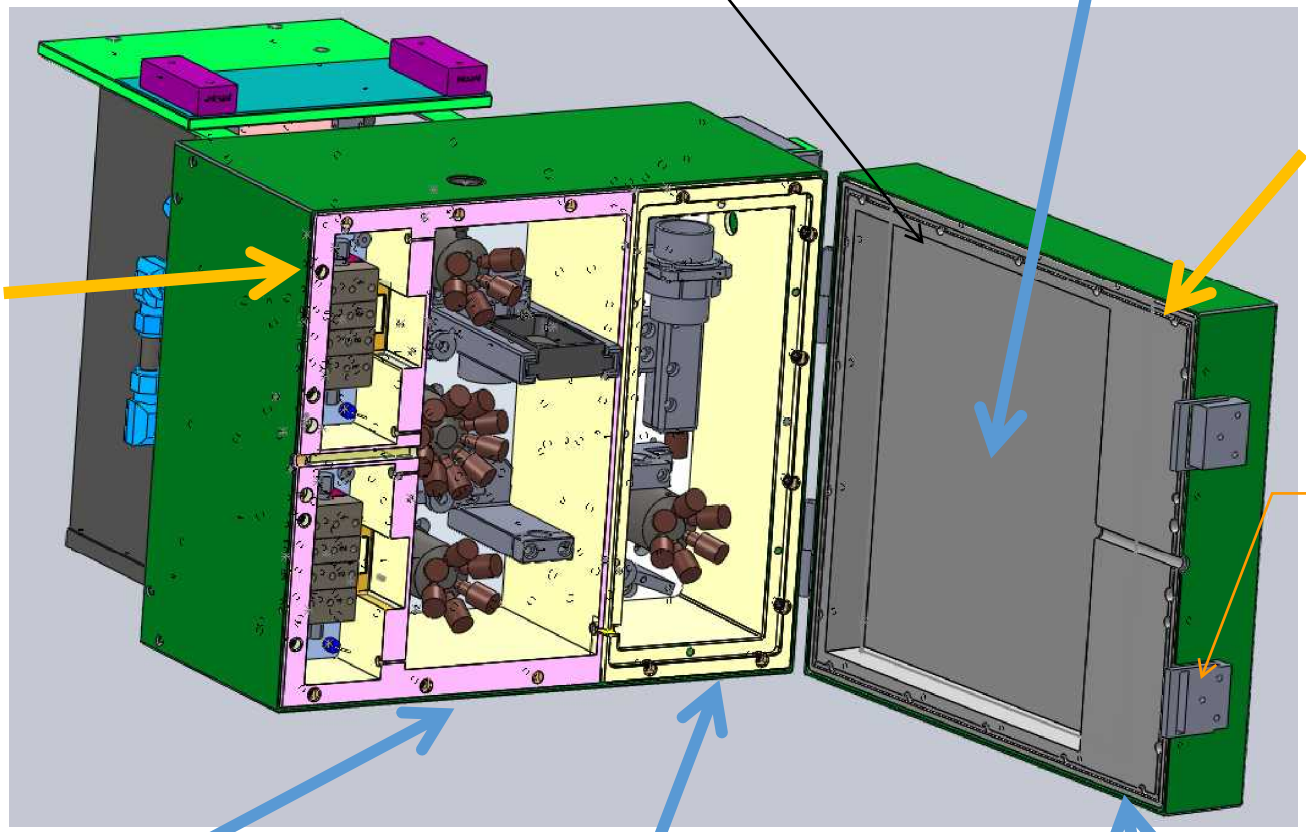
View of Shell Assembled with Frame Components



Grainger part# 5CRV4, Draw Latch, Release to Open, Draw to Close

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

HPLC Box with Masks Installed



Print in two sections:
mask_front3(LEFT).STL
mask_front3(RIGHT).STL

Door Main
Mask Cover
(affix to *Door PLA Mask* with 6-32 screws)

Affix mask
To frame with
6-32 socket
head screws

Affix mask
To frame with
6-32 socket
head screws

Grainger part#
5CRV4, Draw
Latch, Release to
Open, Draw to
Close

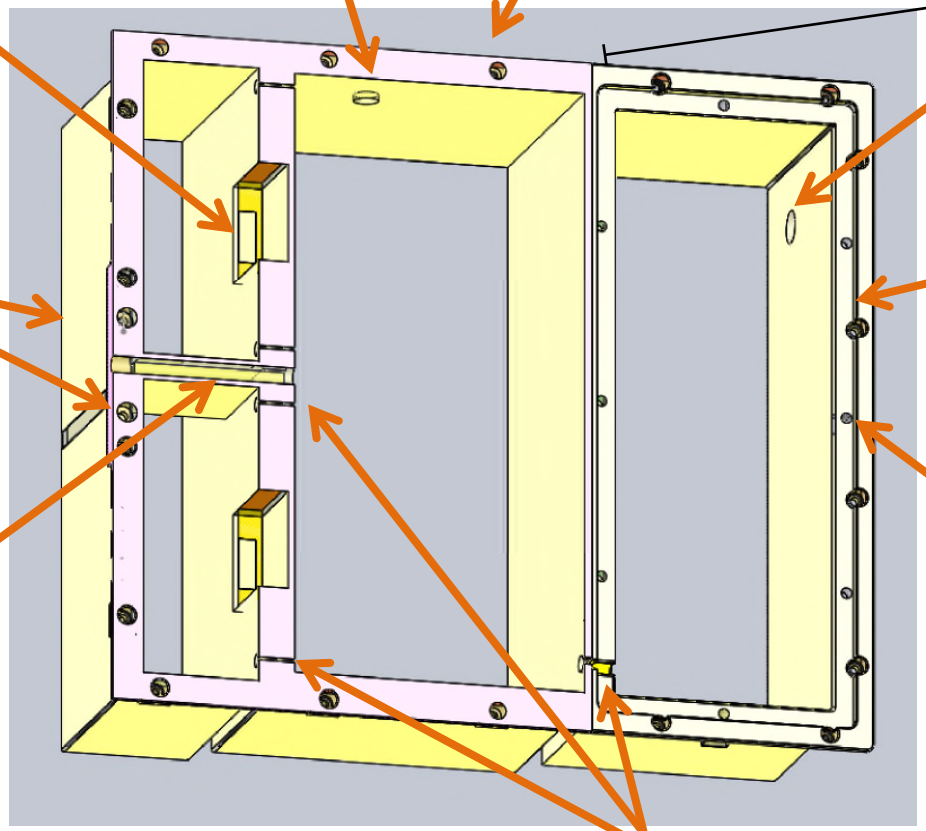
Left Mask (0C)

Analytical
Chamber Mask

Door PLA Mask

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

HPLC Chamber Masks (front)



Recessed notch where thermistor & heater circuits connect

Injection port

Countersunk, reinforced holes around perimeter

Mask is in two separated printed ~~pieces~~, divided here

Exit port

Countersunk, Perimeter for Insulated hatch

Alignment cusps

Reducing cell Cable passageway

Install 4-40 heat-set insets into Inner perimeter holes

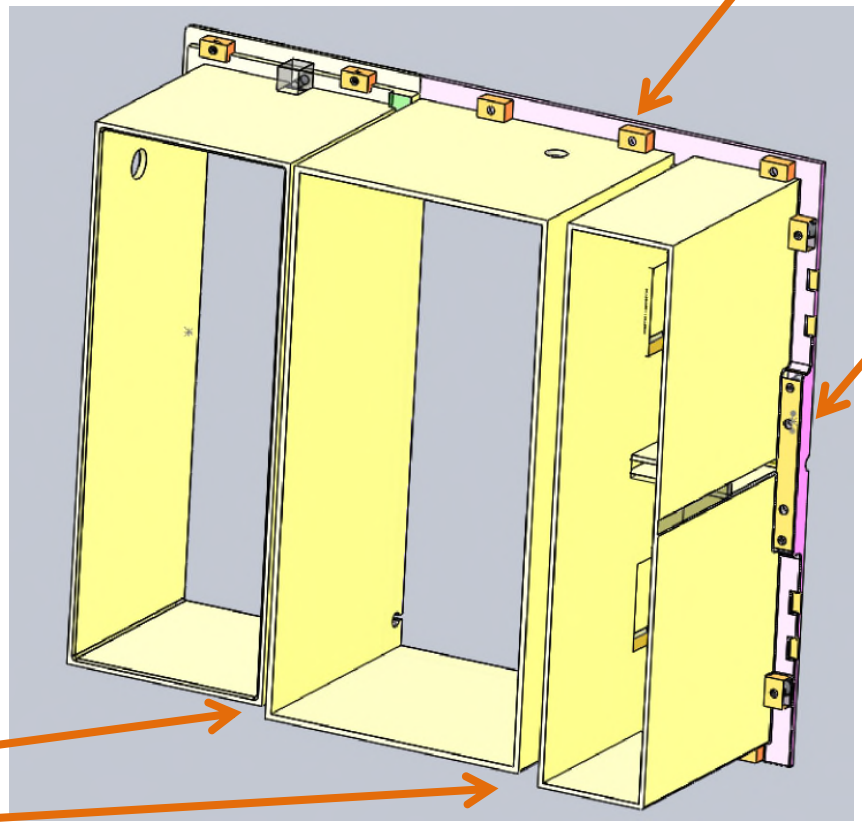
Capillary Passageways

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

HPLC Chamber Masks (rear)

Perimeter reinforcement
shoulder for mounting hole

Dividing line
Between sections



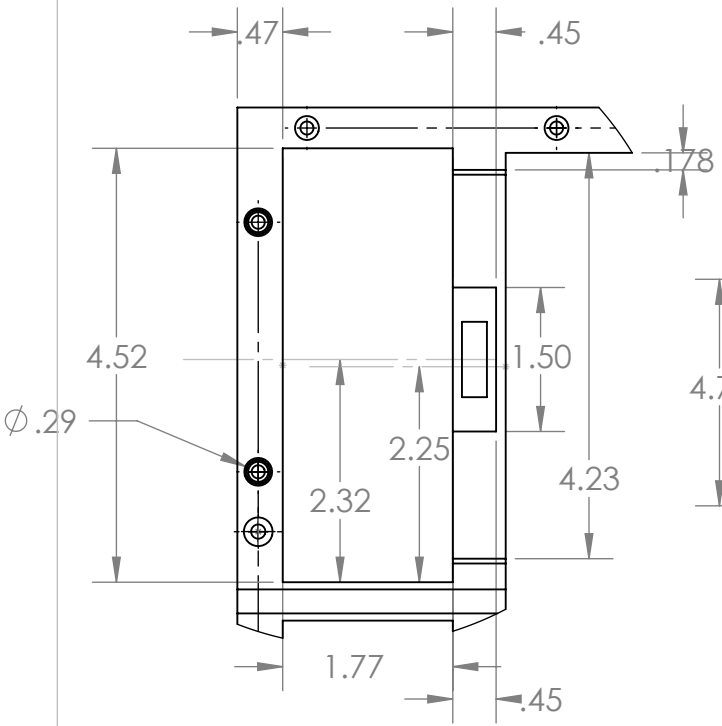
3-D print
In PLA

Reinforcement
For alignment
pins

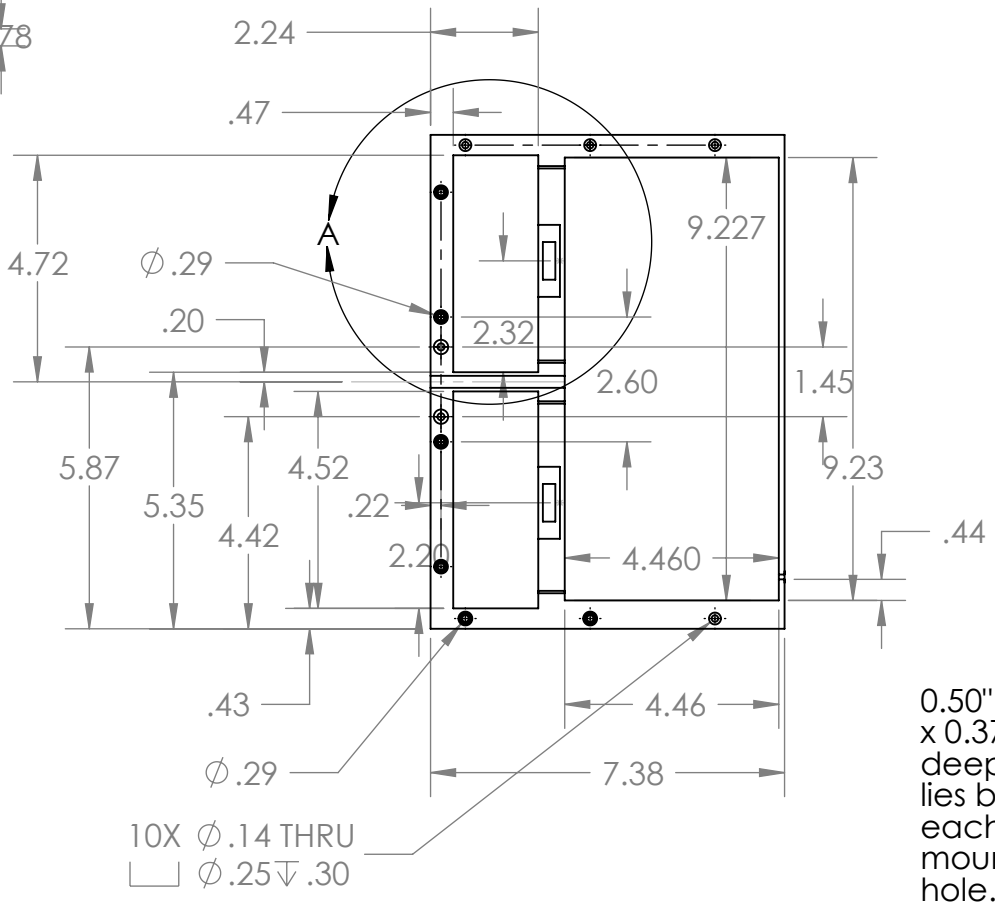
We found that the door is stiff enough that the alignment pins are unnecessarily, but the feature remains in this 3D printing STL file.

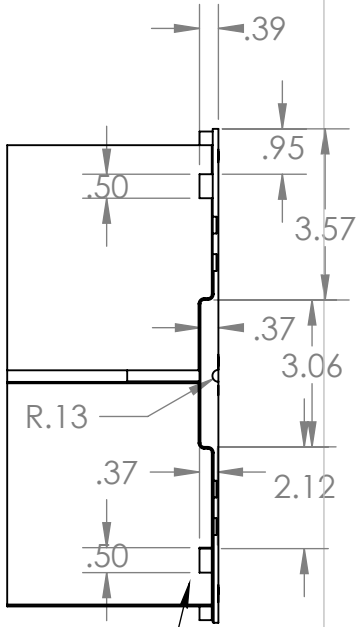
Pack Aerogel
Insulation between
Chambers and between walls and metal box

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



DETAIL A
SCALE 1 : 2





0.50" wide x 0.37" deep tab lies behind each mounting hole.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3-D Print in PLA

TITLE:

Left Mask (0C) (Page 1 of 4)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 4

5 4 3 2 1

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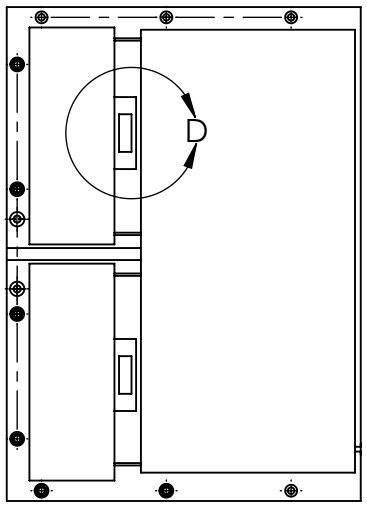
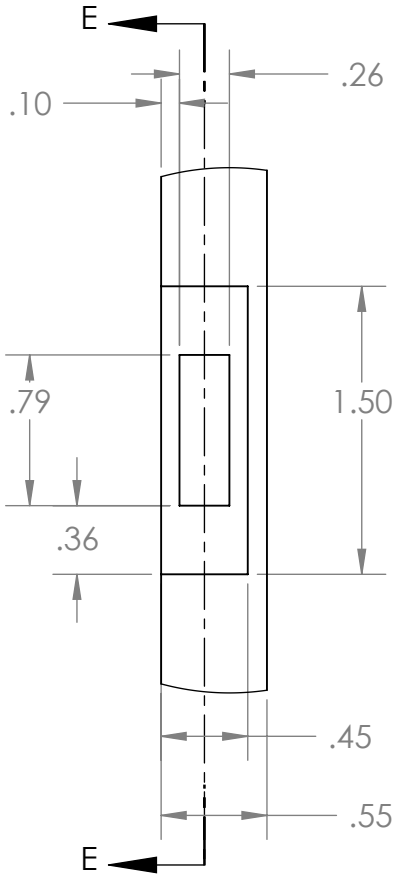
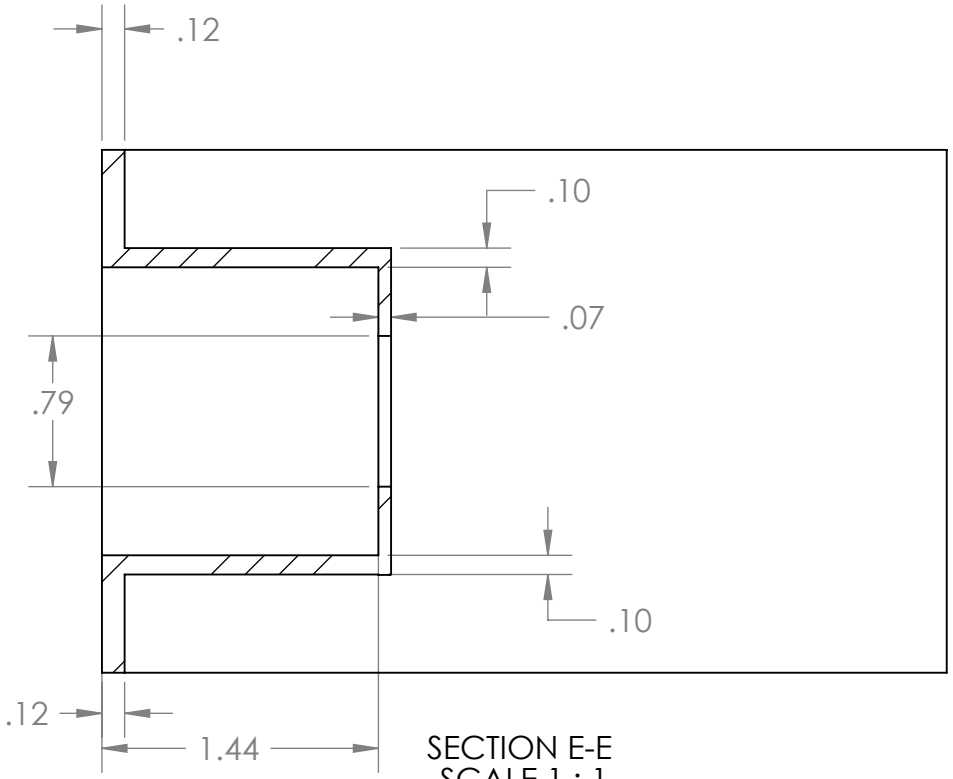




DETAIL D
SCALE 1 : 1



SECTION E-E
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

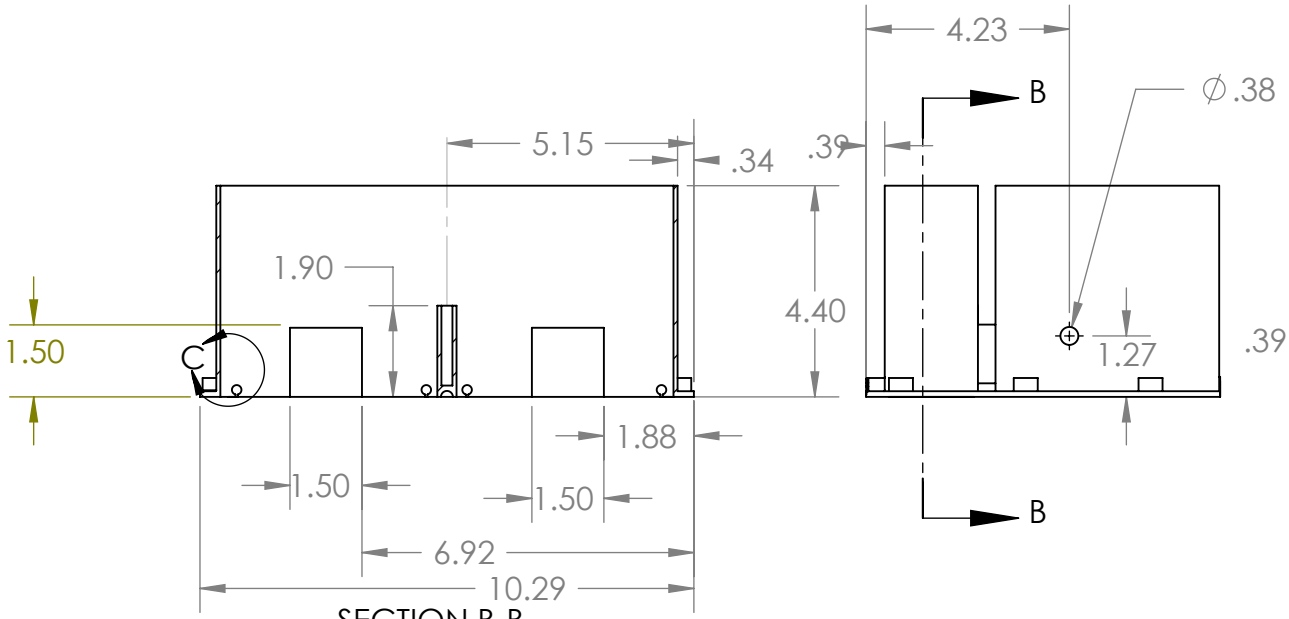
TITLE:
Left Mask (0C)
(Page 2 of 4)

SIZE | DWG. NO. | REV
Amask4a(0C)

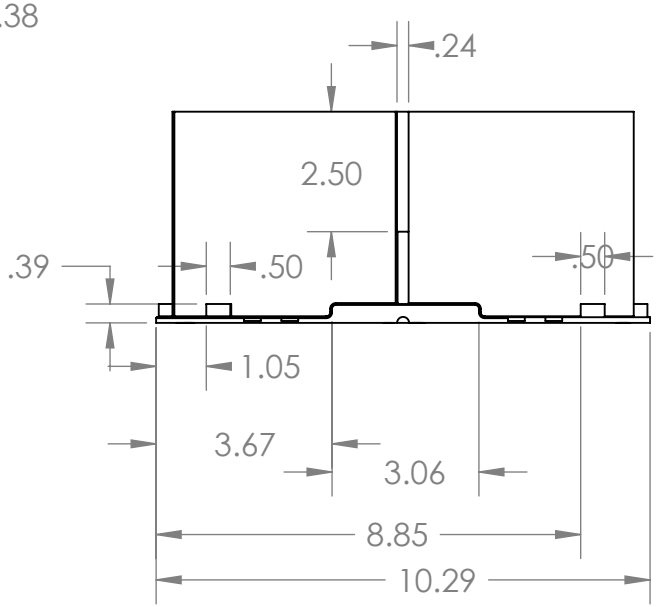
SCALE: 1:4 | WEIGHT: | SHEET 2 OF 4

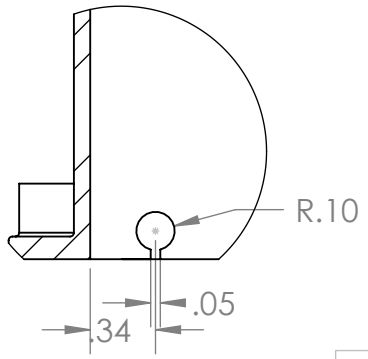
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



SECTION B-B





DETAIL C
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

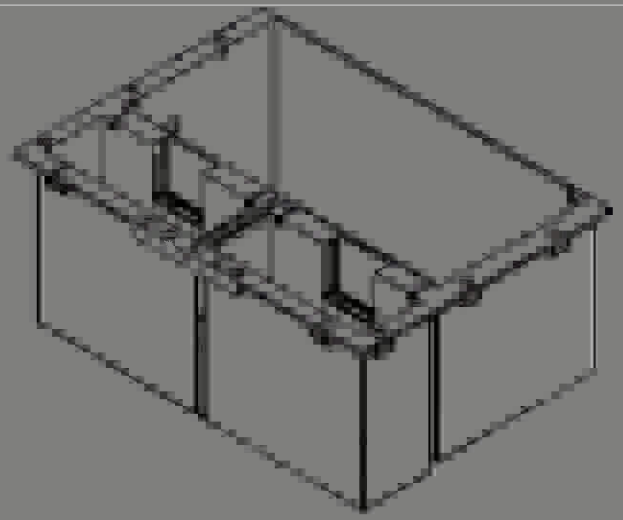
TITLE:

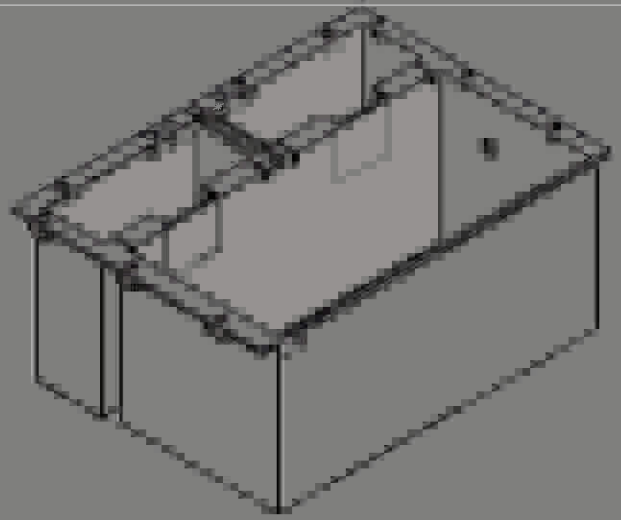
Left Mask (0C) (Page 3 of 4)

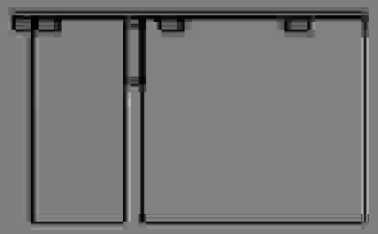
SIZE	DWG. NO.	REV
	Amask4a(0C)	
SCALE: 1:4	WEIGHT:	SHEET 3 OF 4

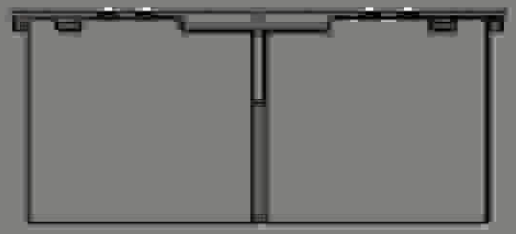
5 4 3 2 1

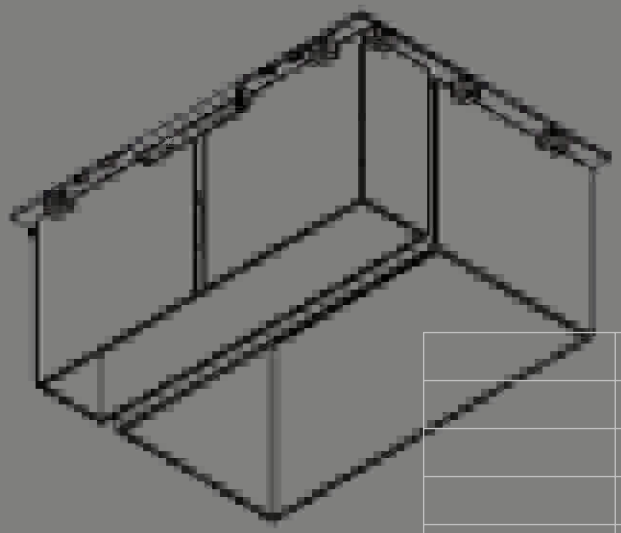
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485











		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
		MATERIAL			
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Left Mask (0C) (Page 4 of 4)

SIZE	DWG. NO.	REV
	Amask4a(0C)	

SCALE: 1:4	WEIGHT:	SHEET 4 OF 4

5 4 3 2 1

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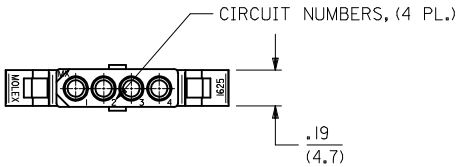
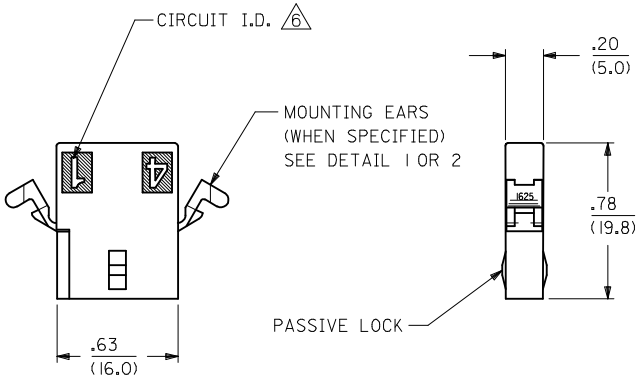
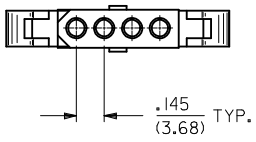
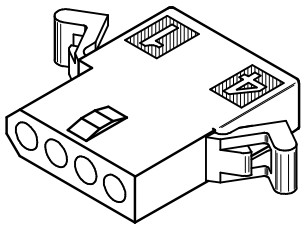
Use the four-contact version of these connectors to fabricate the internal cable between "mask4a(0)" and the 37-pin connector. (Ref. Heating & Sensor Wiring Table.)

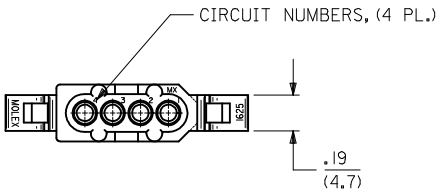


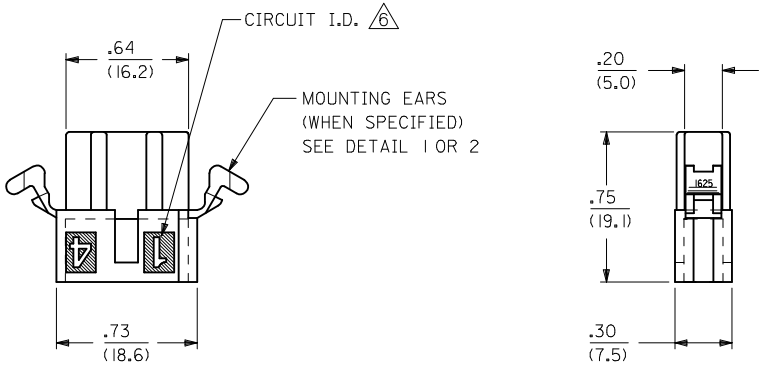


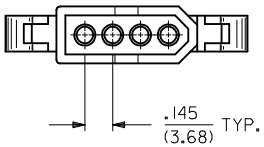


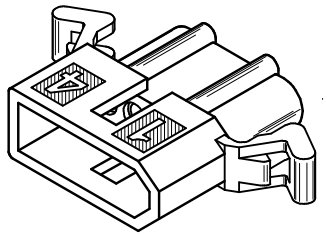


RECEPTACLE HOUSING









PLUG HOUSING

Plastic 4-contact Plug/ Receptacle used in protease chamber mask

REMOVE RCPT. EAR NUB
EC NO: UCP2014-2451 2013/12/12
DRWN:AELHAG 2013/12/12
CH'KD:JBELL
APPR:FSMITH 2013/12/20
DESCRIPTION
REV R3

QUALITY SYMBOLS
F =0
F =0
F =0

GENERAL TOLERANCES (UNLESS SPECIFIED)

	mm	INCH
4 PLACES	± ---	± ---
3 PLACES	± ---	± .010
2 PLACES	± 0.25	± .014
1 PLACE	± 0.36	± ---
ANGULAR ± 1 °		

DRAFT WHERE APPLICABLE MUST REMAIN WITHIN DIMENSIONS

DIMENSION STYLE: IN/MM
SCALE: ---
DESIGN UNITS: INCH
THIRD ANGLE PROJECTION

DRAWN BY AELHAG DATE 2010/06/30
CHECKED BY JBELL DATE 2012/01/23
APPROVED BY FSMITH DATE 2011/12/02
MATERIAL NO. SEE CHART

TITLE: PLUG & RECEPTACLE HOUSINGS, 4 CIRCUIT, .062 DIA., .145 CENTERS
molex MOLEX INCORPORATED
DOCUMENT NO. SD-1625-4*
SHEET NO. 1 OF 2
SIZE C

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

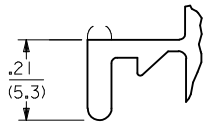
PLUG		
PART NO.	ENG. NO.	
03-06-2041	1625-4P	
46999-0267	1625-4P-1	
03-06-7041	1625-4PBK	OBSOLETE
03-06-2042	1625-4P1	
03-06-7042	1625-4P1BK	
46999-0355	1625-4P2	
NOT TOOLED	1625-4P2BK	
46999-0353	1625-4P2-1	
	-	

RECEPTACLE		
PART NO.	ENG. NO.	
03-06-1041	1625-4R	
03-06-6041	1625-4RBK	OBSOLETE
03-06-1042	1625-4R1	
03-06-6042	1625-4R1BK	
50-29-1758	1625-4R2	
46999-0266	1625-4R2-1	
46999-0354	1625-4R1-1	
	-	
	-	

LEGEND:

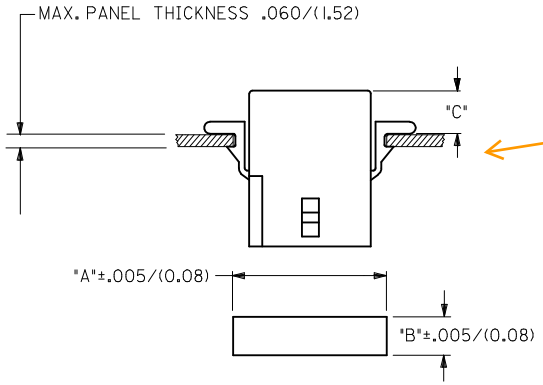
1625-4***-*

- CIRCUIT SIZE
- R = RECEPTACLE
  P = PLUG
- BLANK = WITH STANDARD MTG. EARS
  1 = WITHOUT EARS
  2 = WITH PREBENT MTG. EARS
- BLANK = NOT DYED
  AM=AMBER BK=BLACK BU=BLUE
  BN=BROWN GY=GRAY GN=GREEN
  OR=ORANGE RD=RED YW=YELLOW
- BLANK = MATERIAL CODE A
  1 = MATERIAL CODE B



DETAIL 1

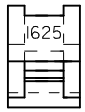
STANDARD MOUNTING EARS
(SCALE 4:1)

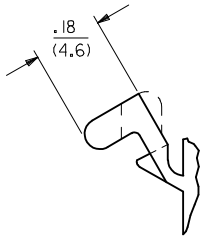


RECOMMENDED PANEL OPENING

HOUSING	DIM. "A"	DIM. "B"	"C" PREBENT EAR	"C" STANDARD EAR
PLUG	.865/(21.97)	.312/(7.92)	.19/(4.8)	.18/(4.6)
RECEPT.	.785/(19.94)	.260/(6.60)	.21/(5.3)	.20/(5.1)

Use Plug-type connector to insert into bulkheads of "Left Mask (0C)"





DETAIL 2

PREBENT MOUNTING EARS
(SCALE 4:1)

NOTES:
1. MATERIAL:
   A = NYLON TYPE 6/6, 94V-2
   B = NYLON PA6, UL94V-2, COLOR: NATURAL
   IEC 60335-1, 4th EDITION, GLOW WIRE CAPABLE
2. FINISH: N/A.
3. THIS PRODUCT COMPLIES WITH MOLEX PRODUCT SPECIFICATION PS-02-06
4. PACKAGING: PK-1625-003.
5. HOUSINGS FOR USE WITH MOLEX .062/(1.57) DIA. SERIES TERMINALS.
6. CIRCUIT I.D. NUMBERS ON SIDE OF HOUSING APPEAR ON PARTS FROM TOOLS BUILT AFTER 8/10/92. PARTS FROM TOOLS BUILT BEFORE THIS DATE WILL HAVE CIRCUIT I.D. RIBS ON HOUSING.
7. PARTS CONFROM TO CLASS 'B' REQUIREMENTS OF COSMETIC SPECIFICATION PS-45499-002.

UPDATE REV. LEVEL
EC NO: UCP2014-2451 2013/12/12
DRWN:AELHAG 2013/12/12
CHKD:JBELL 2013/12/20
APPR:FSMITH
DESCRIPTION
R3
REV

QUALITY SYMBOLS
E =0
E =0
E =0

GENERAL TOLERANCES (UNLESS SPECIFIED)

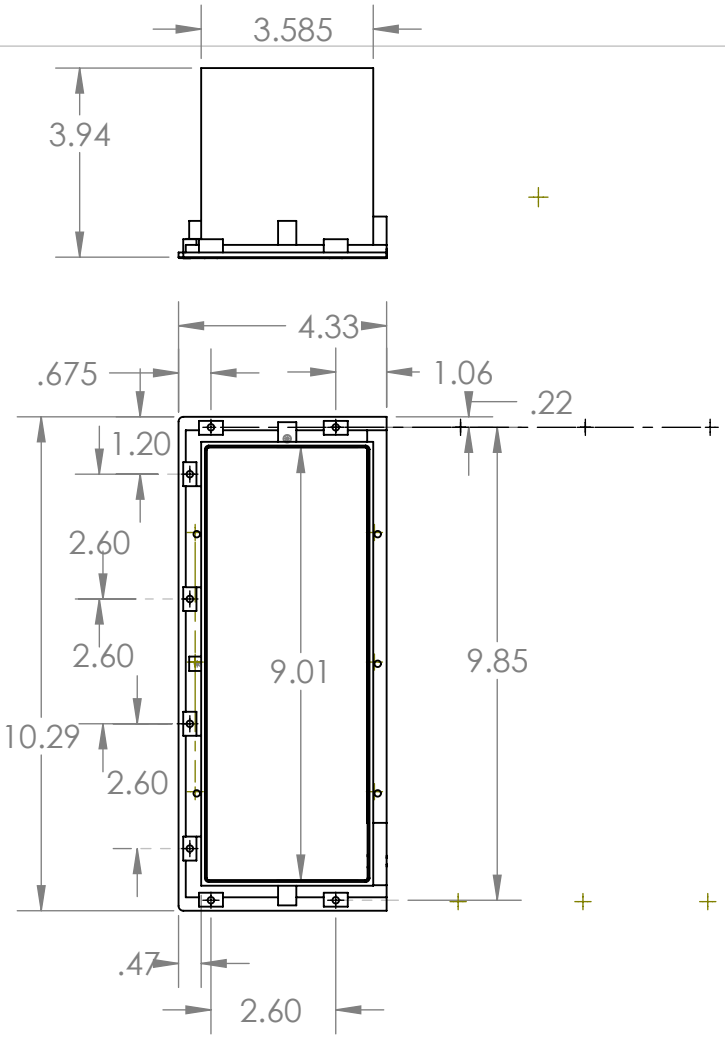
	mm	INCH
4 PLACES	± ---	± ---
3 PLACES	± ---	± .010
2 PLACES	± 0.25	± .014
1 PLACE	± 0.36	± ---

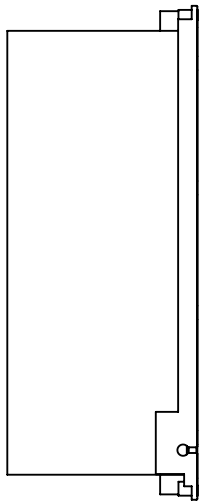
ANGULAR ± 1 °

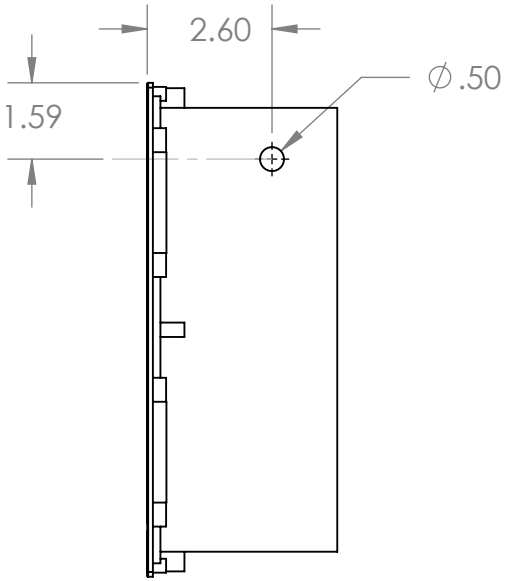
DRAFT WHERE APPLICABLE MUST REMAIN WITHIN DIMENSIONS

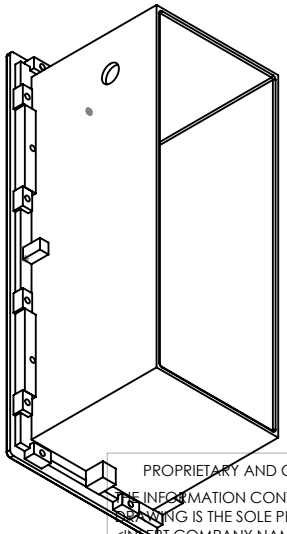
DIMENSION STYLE	IN/MM
SCALE	---
DESIGN UNITS	INCH
	THIRD ANGLE PROJECTION
DRAWN BY / DATE	AELHAG 2010/06/30
CHECKED BY / DATE	JBELL 2012/01/23
APPROVED BY / DATE	FSMITH 2011/12/02
MATERIAL NO.	SEE CHART
TITLE	PLUG & RECEPTACLE HOUSINGS, 4 CIRCUIT, .062 DIA., .145 CENTERS
	molex MOLEX INCORPORATED
DOCUMENT NO.	SD-1625-4*
SHEET NO.	2 OF 2
SIZE	C

Dr. Jeffrey W. Hudgens, jhudgens@nist.gov, 240-314-6485









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		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

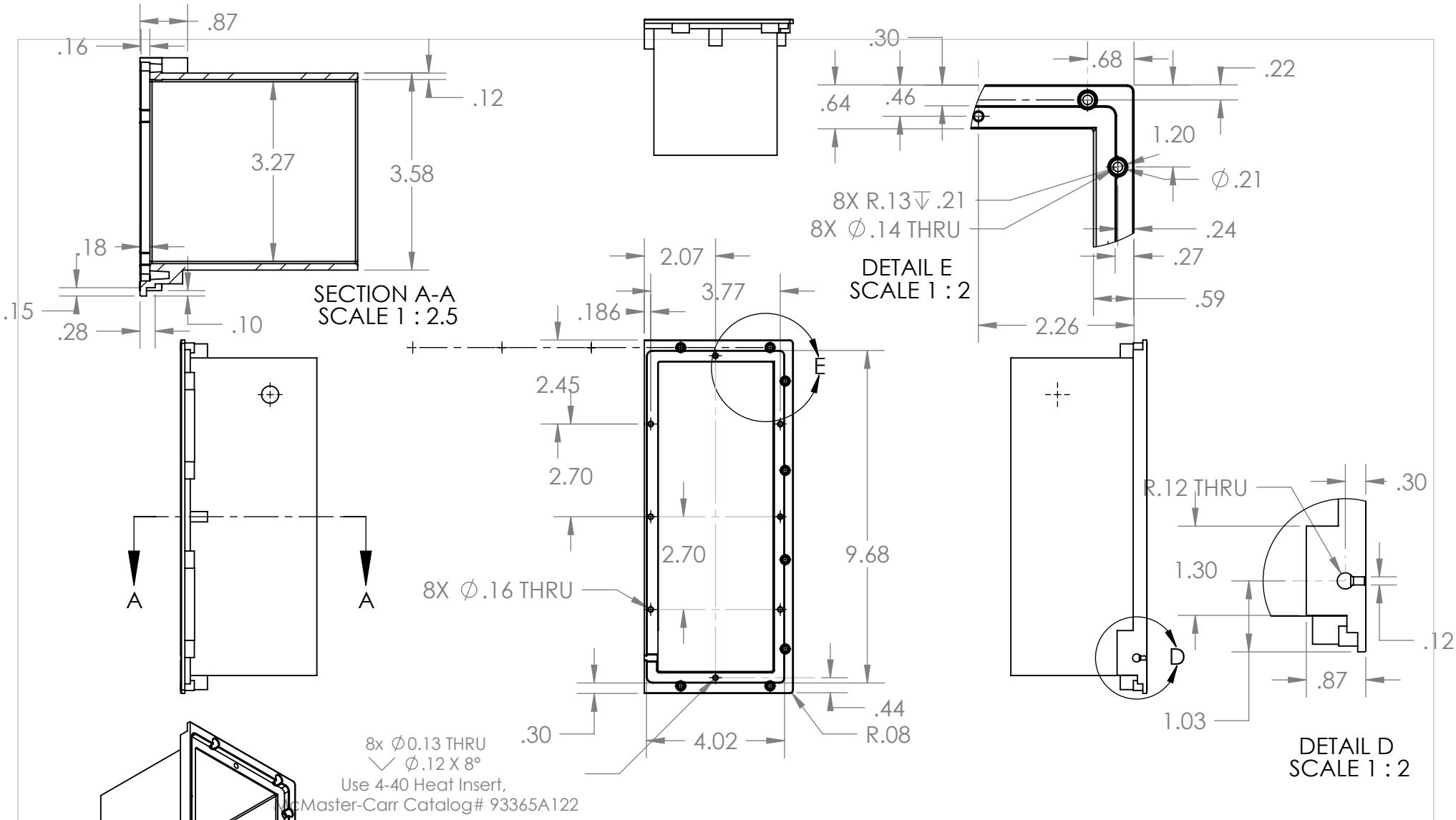
TITLE:
Analytical Chamber
Mask (1 of 3)

SIZE	DWG. NO.	REV
A	mask2(0C)	

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 3

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Analytical Chamber
Mask (2 of 3)

SIZE	DWG. NO.	REV
A	mask2(0C)	

SCALE: 1:4 WEIGHT: SHEET 2 OF 3

5 4 3 2 1

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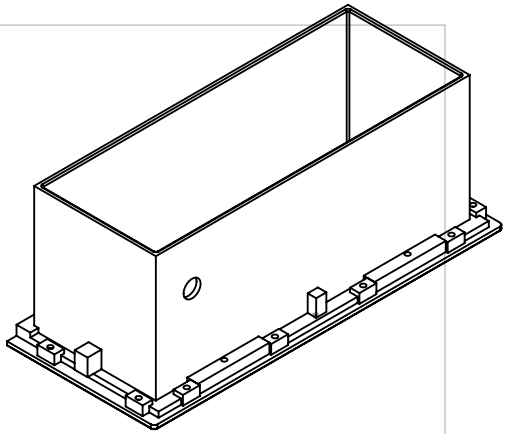

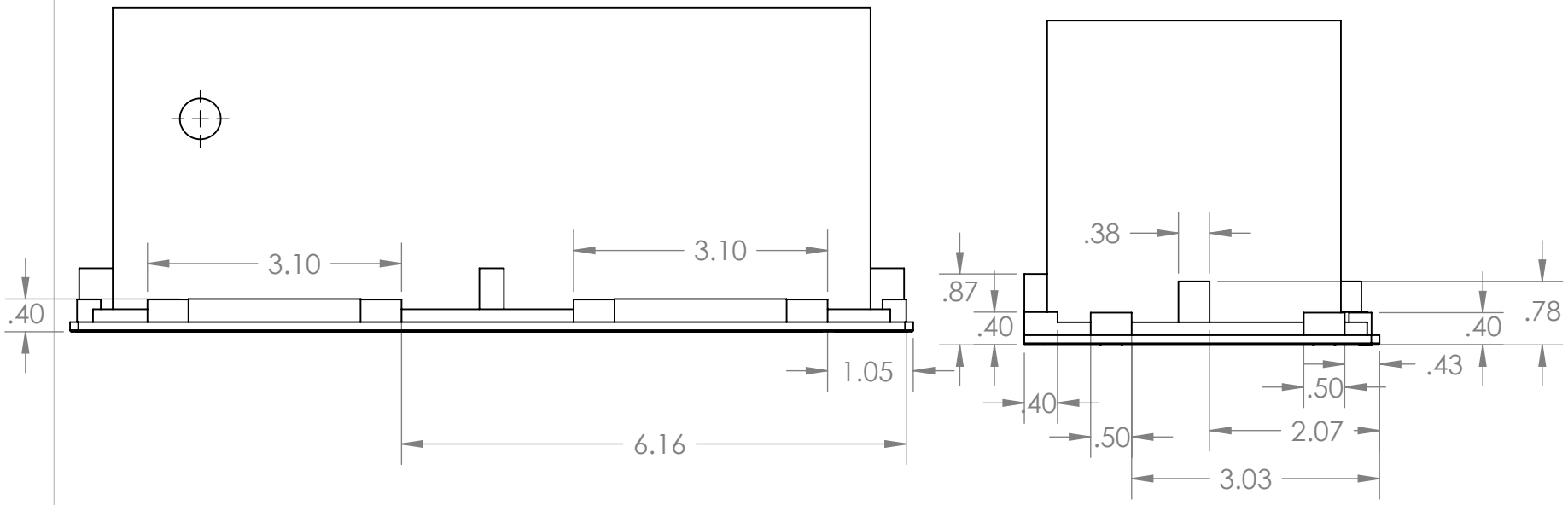

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: Analytical Chamber Mask (3 of 3)

SIZE	DWG. NO.	REV
A	mask2(0C)	

SCALE: 1:4 WEIGHT: SHEET 3 OF 3

5 4 3 2 1

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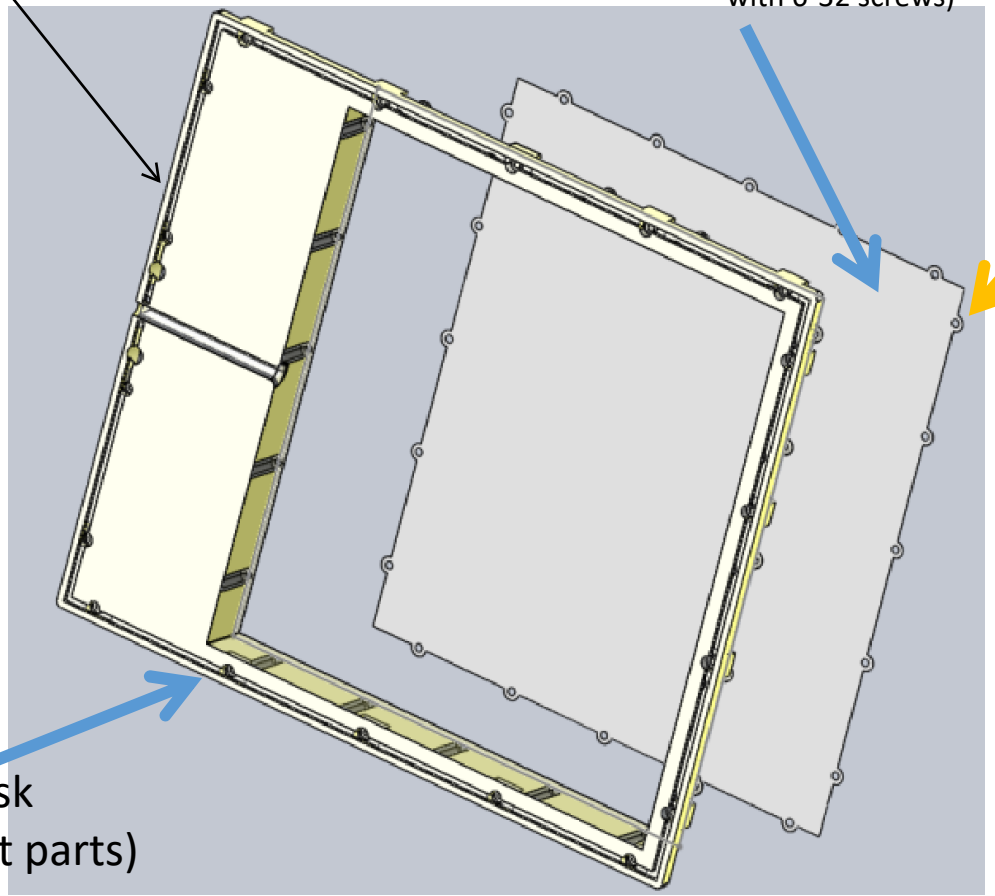
Door Mask Assembly

If you have an extra-large format printer, use file "mask_front3_ALL.STL" to print in one piece.

Use files "mask_front3(LEFT).STL" "mask_front3(RIGHT).STL" to print in two pieces.

Door Main Mask Cover (mask3_cap.STL)
(affix to *Door PLA Mask* with 6-32 screws)

Affix mask To frame with 6-32 socket head screws



Door PLA Mask
(Left and right parts)

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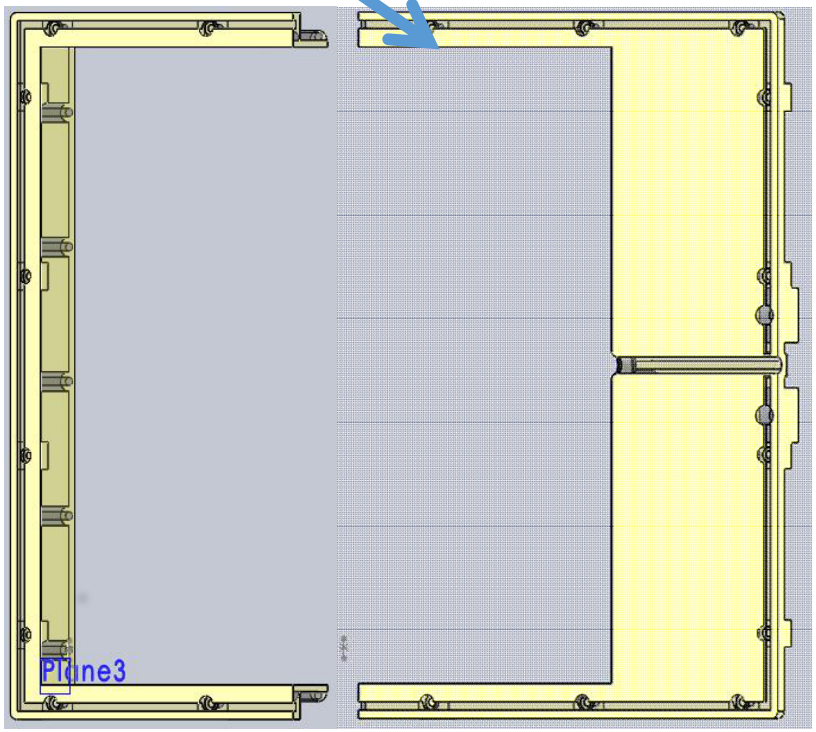
Door Mask Frame-Mounting Parts

mask_front3(right).STL)

mask_front3(LEFT).STL



NOTE: The above STL files will fit the platens of most medium format (11”x11”) 3D printers. A Larger Format Printer may print the file: mask_front3_ALL.STL, which contains the left and right parts together.

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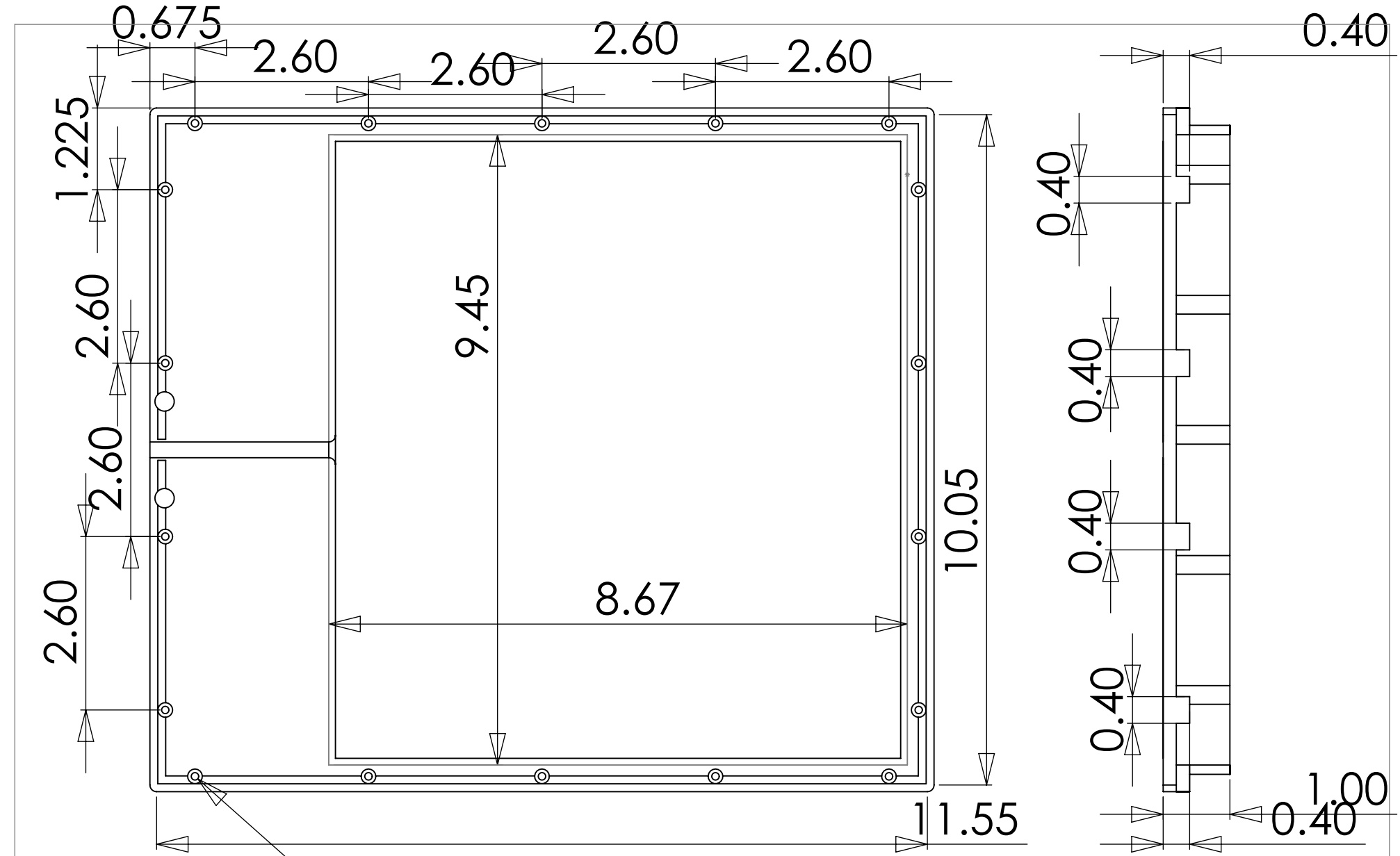

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			DRAWN	
			CHECKED	
			ENG APPR.	
			MFG APPR.	
			Q.A.	
			COMMENTS:	
NEXT ASSY	USED ON	MATERIAL --		
		FINISH --		
APPLICATION		DO NOT SCALE DRAWING		

3D Print in PLA

Door PLA Mask

page 1 of 2

SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 1 OF 2

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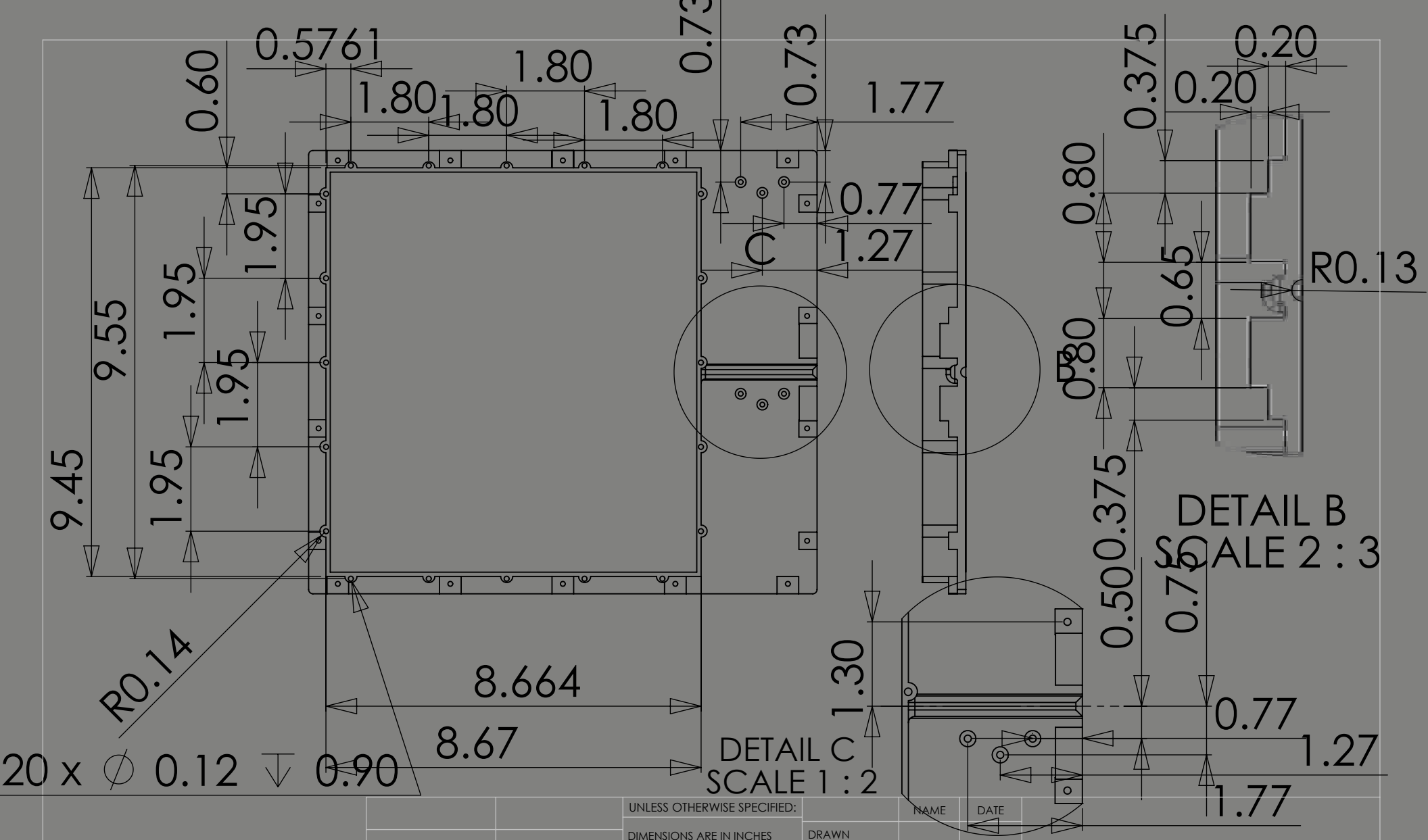

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ±	DRAWN		
			CHECKED		
		TWO PLACE DECIMAL ±	ENG APPR.		
		THREE PLACE DECIMAL ±	MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Door PLA Mask

page 2 of 2

SIZE	DWG. NO.	REV
A	mask_front3	
SCALE: 1:5	WEIGHT:	SHEET 2 OF 2

5 4 3 2 1

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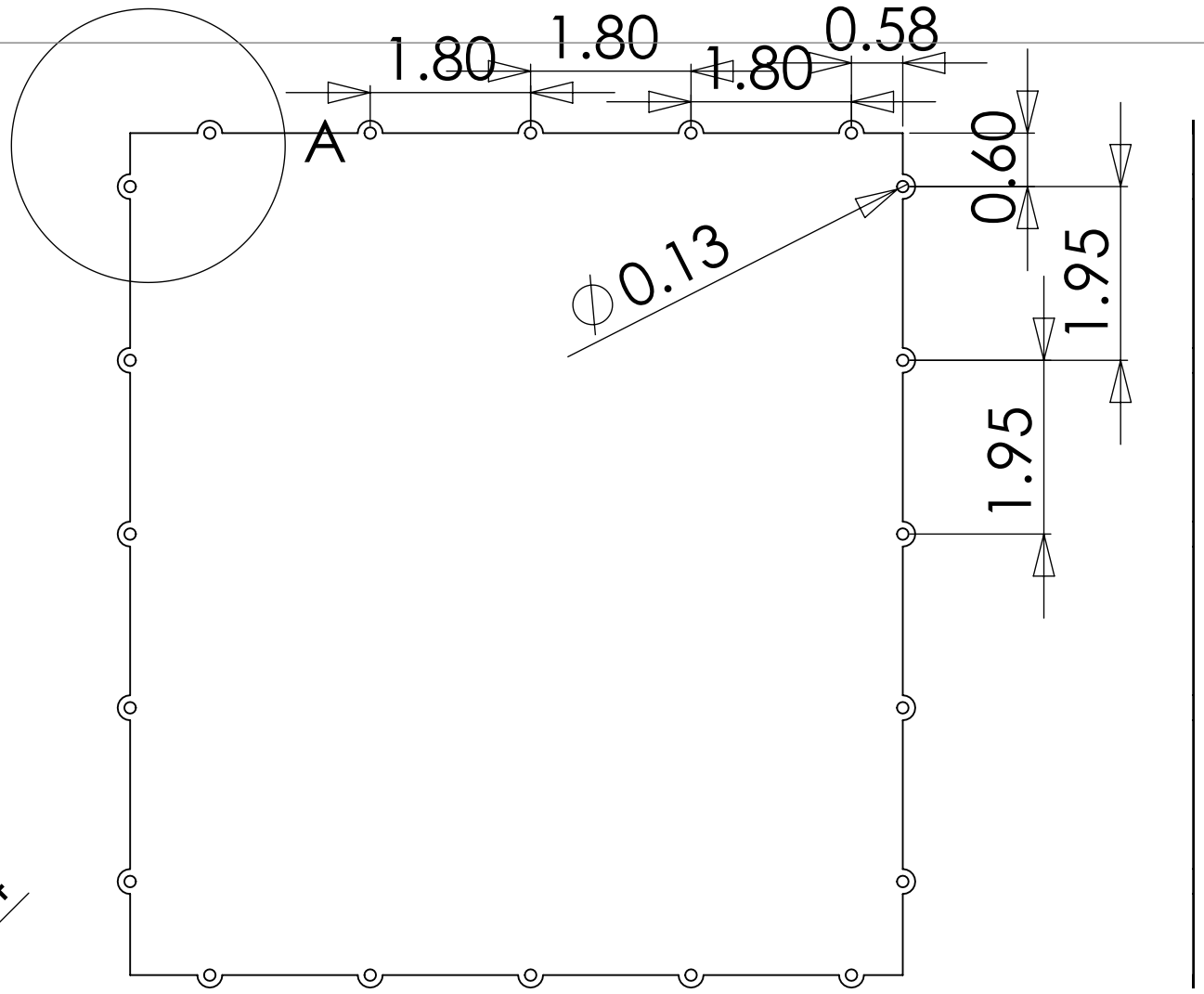

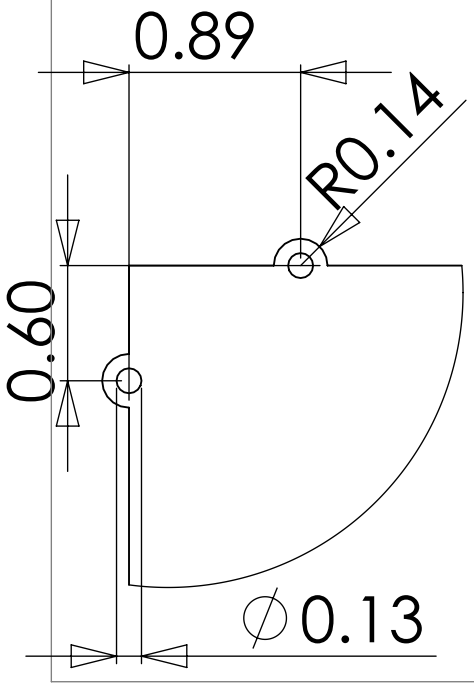

DETAIL A

		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
NEXT ASSY	USED ON	FINISH --	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

Door Mask Main Cover

SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 1 OF 1

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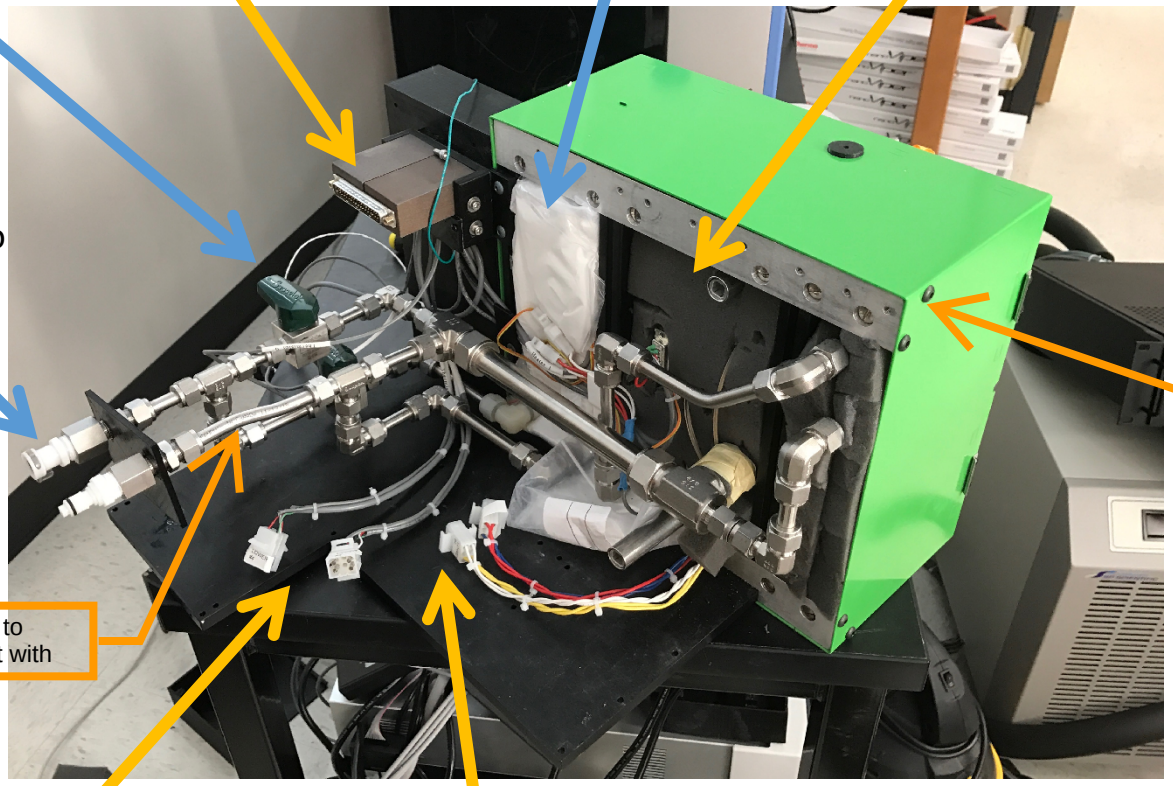
View of Cooling and Electrical System



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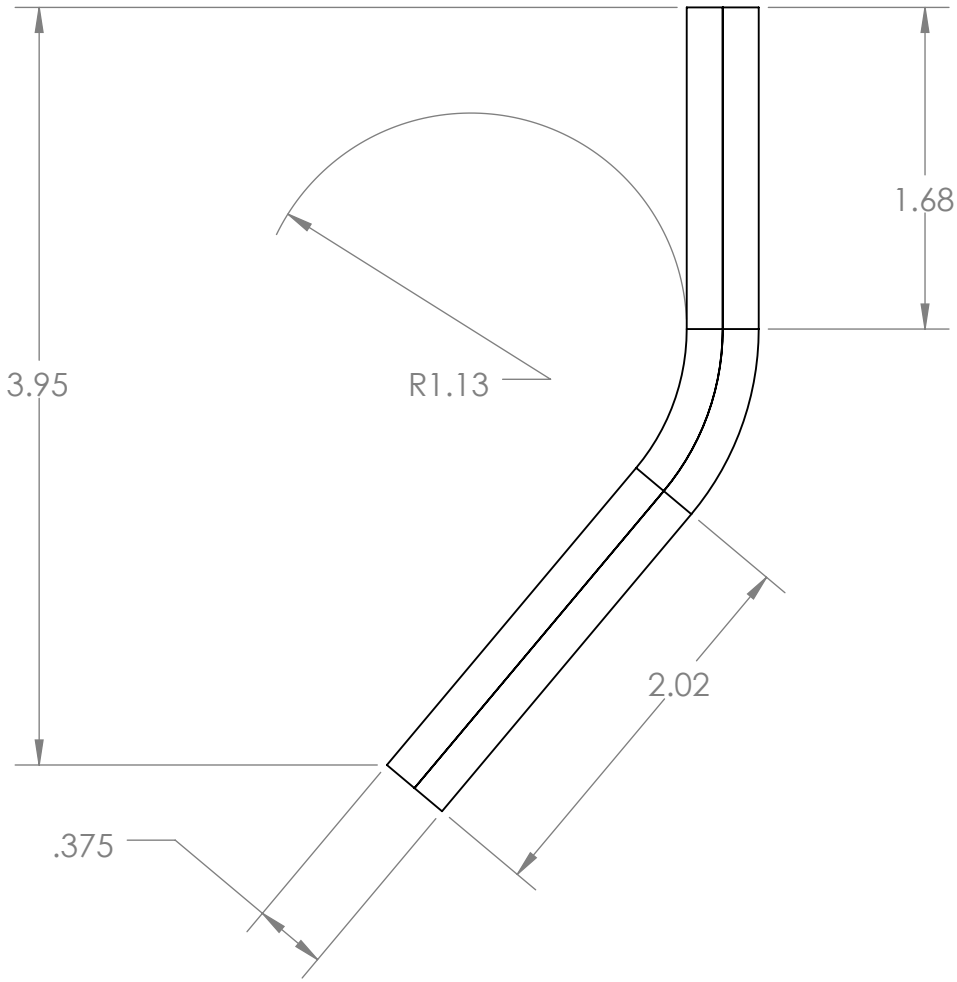

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Protease coolant tube

SIZE	DWG. NO.	REV
TA		

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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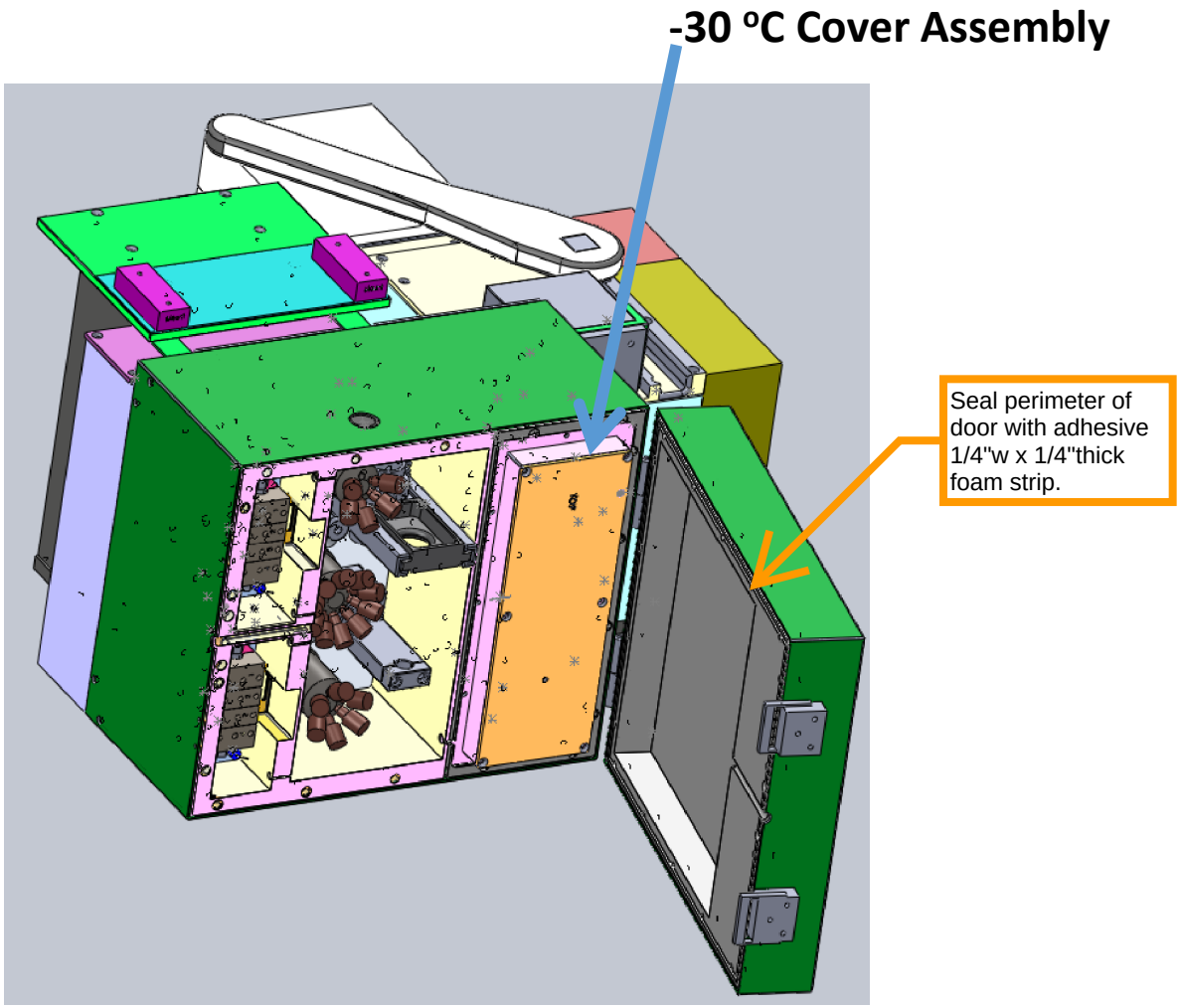
HPLC Box with -30 °C Cover



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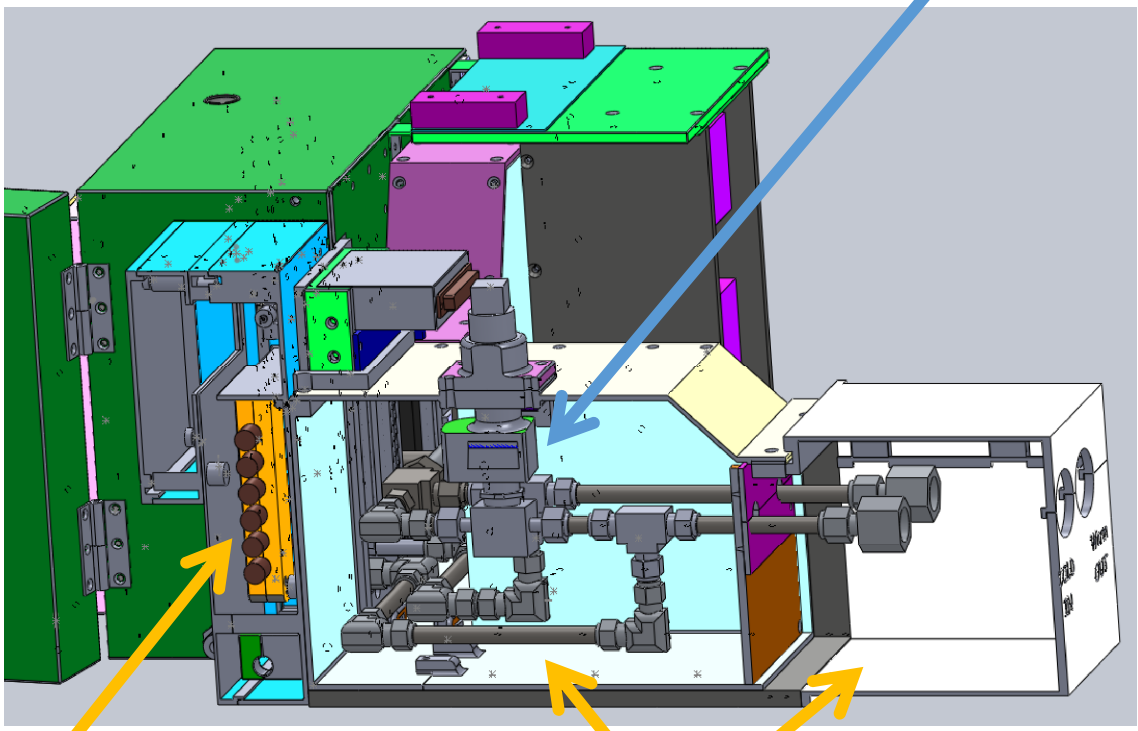
Cross-section View Showing Coolant System



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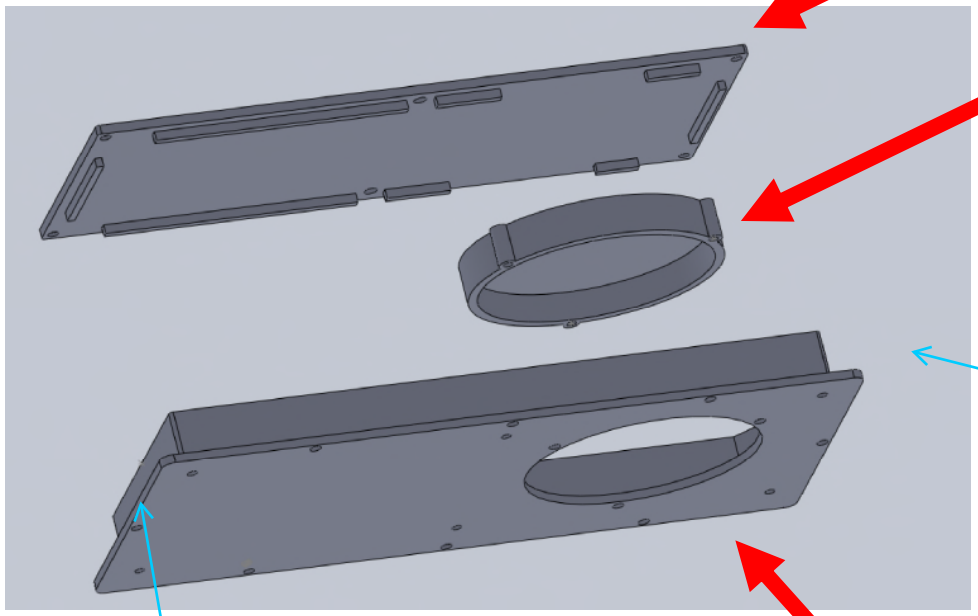
Assembly of Internal -30 ºC Cover

-- Catalog of STL files

-30 ºC Cover,
(-30C)_Cover.STL



Internal (-30C) cap,
internal (-30C) cap.STL

To prevent escape of dust from insulation, seal all interal and external seams.

Insert Insulation on interior

Cover(-30C) base,
cover(-30C).STL

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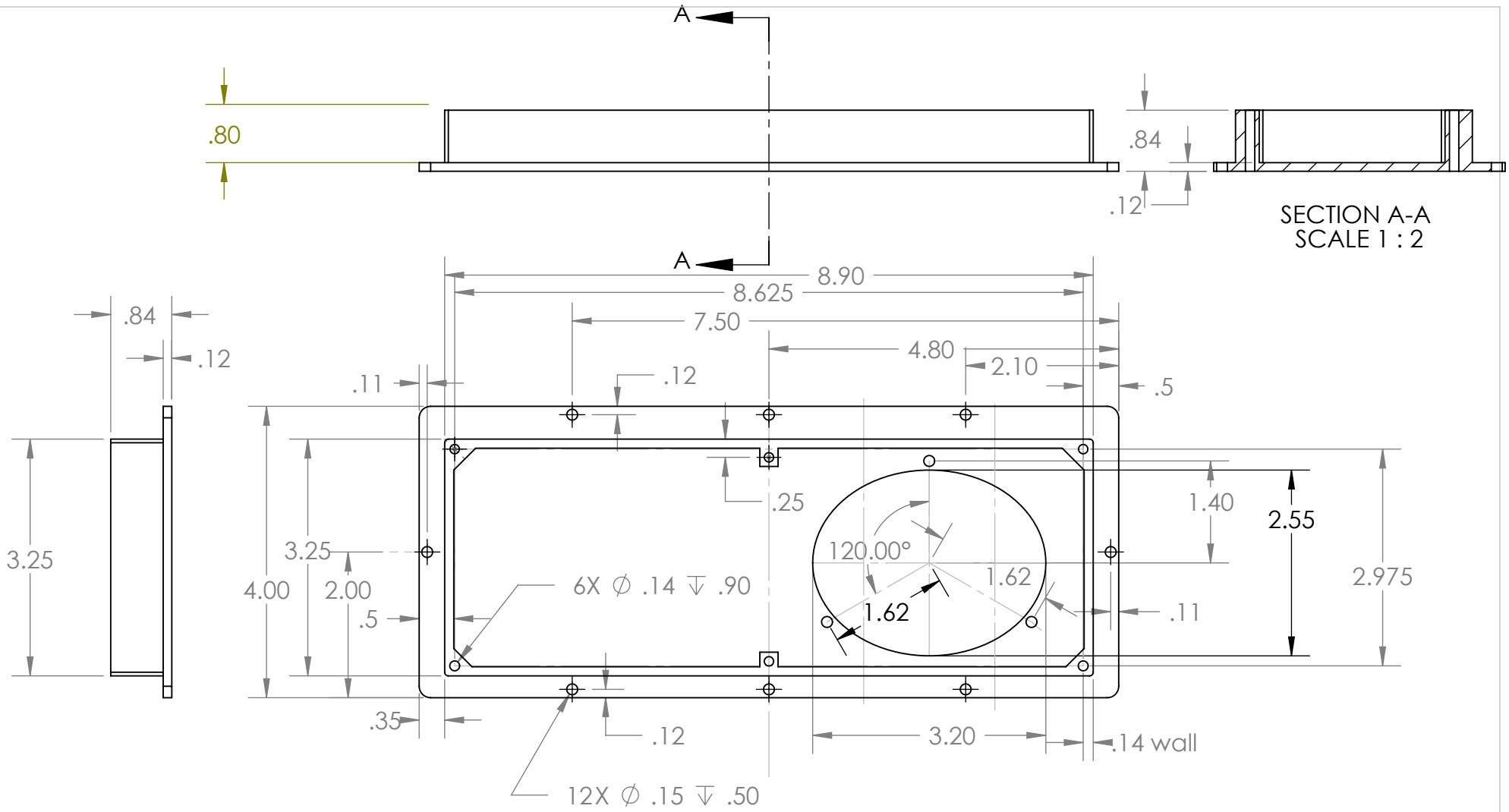

3-D Print in PLA

UNLESS OTHERWISE SPECIFIED:		NAME	DATE		
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN			TITLE: Cover(-30C) base	
	CHECKED				
	ENG APPR.				
	MFG APPR.				
INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.				
MATERIAL	COMMENTS:			SIZE: A	DWG. NO.: cover(-30C)
FINISH					REV:
NEXT ASSY / USED ON				SCALE: 1:4	WEIGHT:
APPLICATION / DO NOT SCALE DRAWING					SHEET 1 OF 1

5 4 3 2 1

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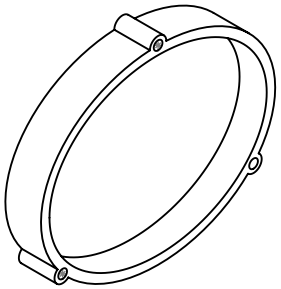
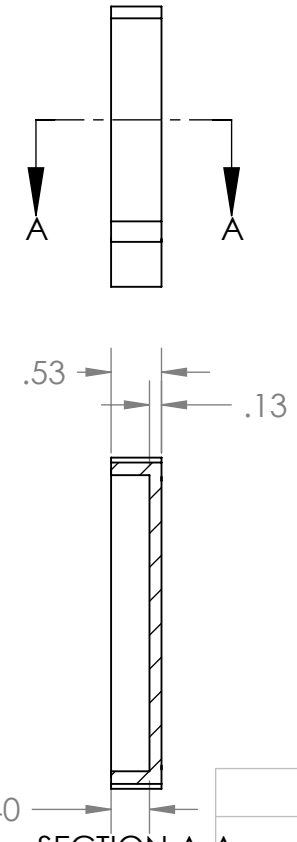
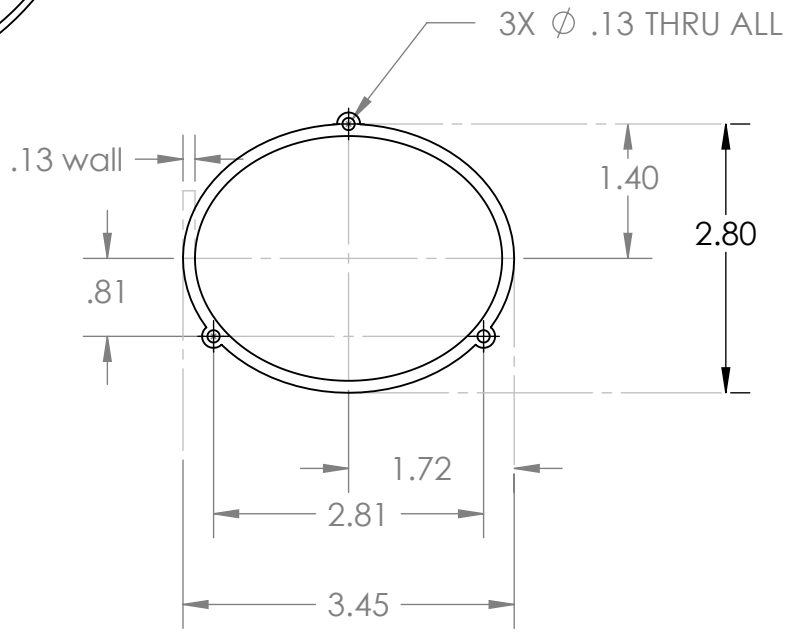




SECTION A-A



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Internal (-30C) cap

SIZE	DWG. NO.	REV
A		

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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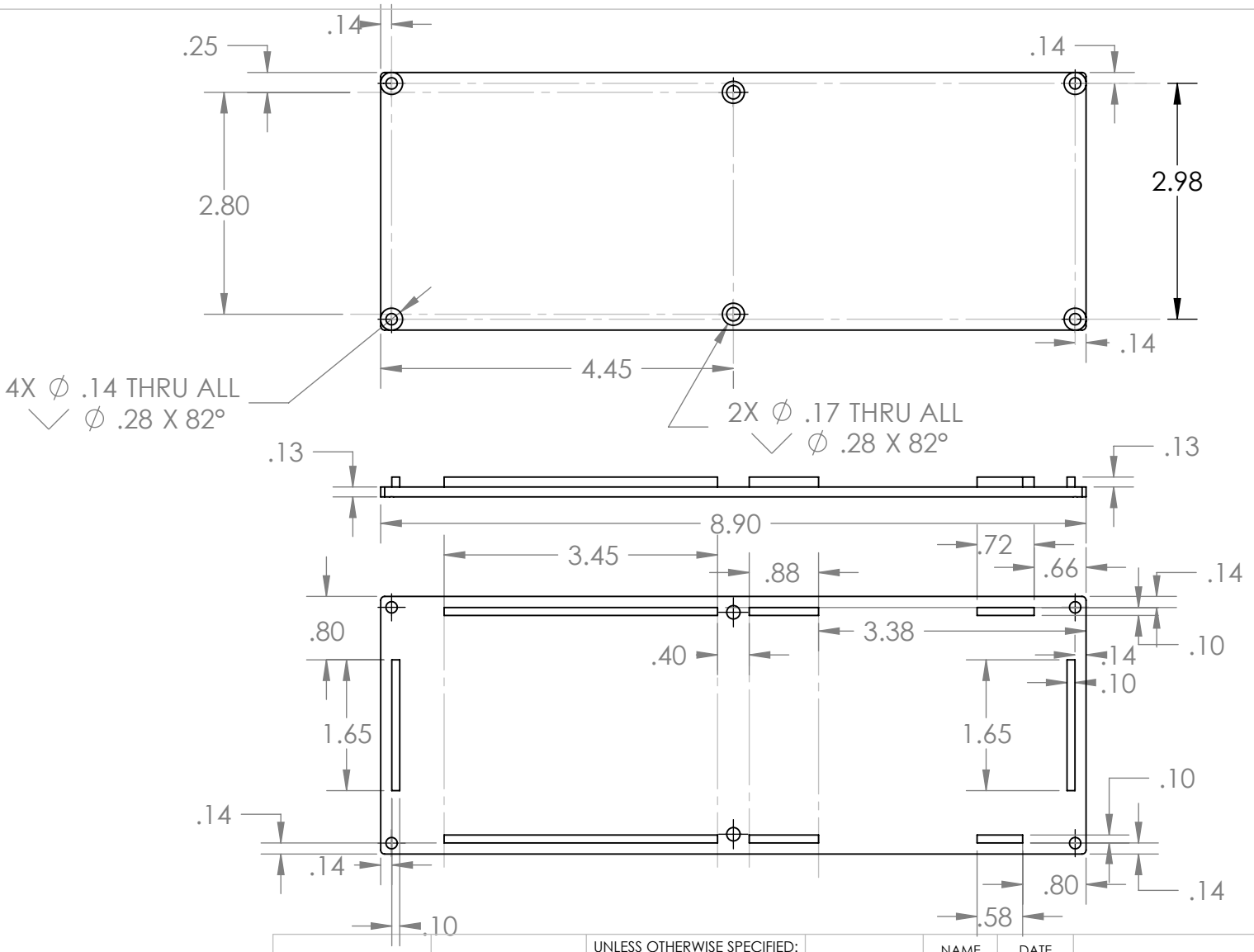

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

-30C Cover

SIZE	DWG. NO.	REV
A	(-30C)_Cover	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1

5 4 3 2 1

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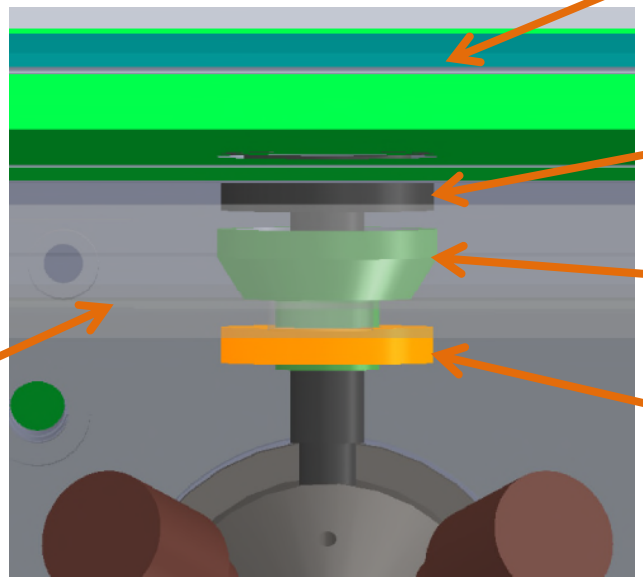
Sealing Assembly at Injection Port



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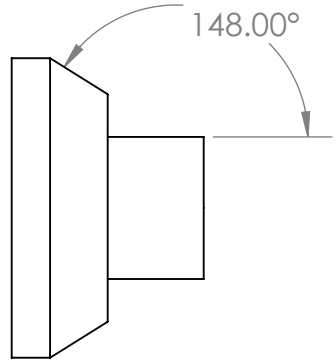

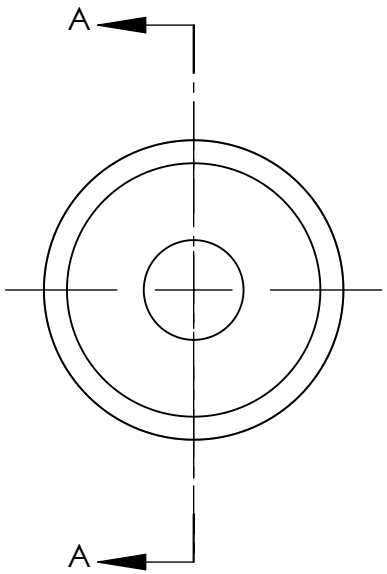

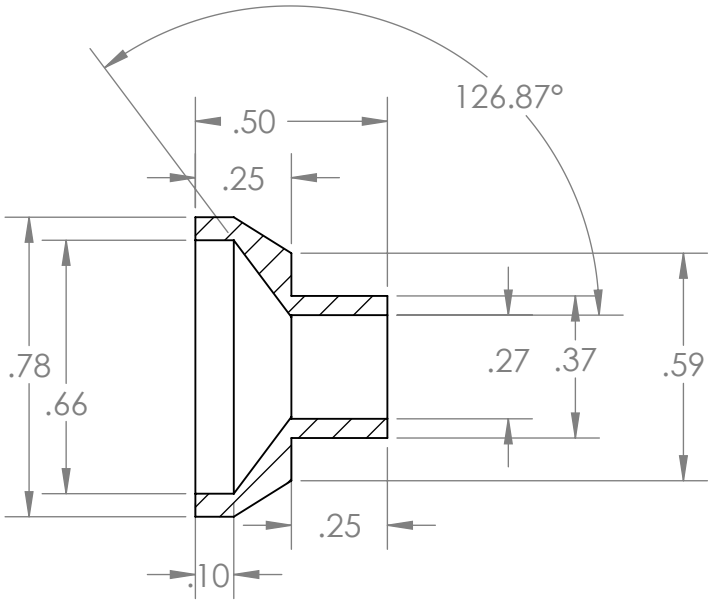

SECTION A-A

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

TITLE:

Dust protector for injection port

SIZE	DWG. NO.	REV
A	Funnel	

SCALE: 2:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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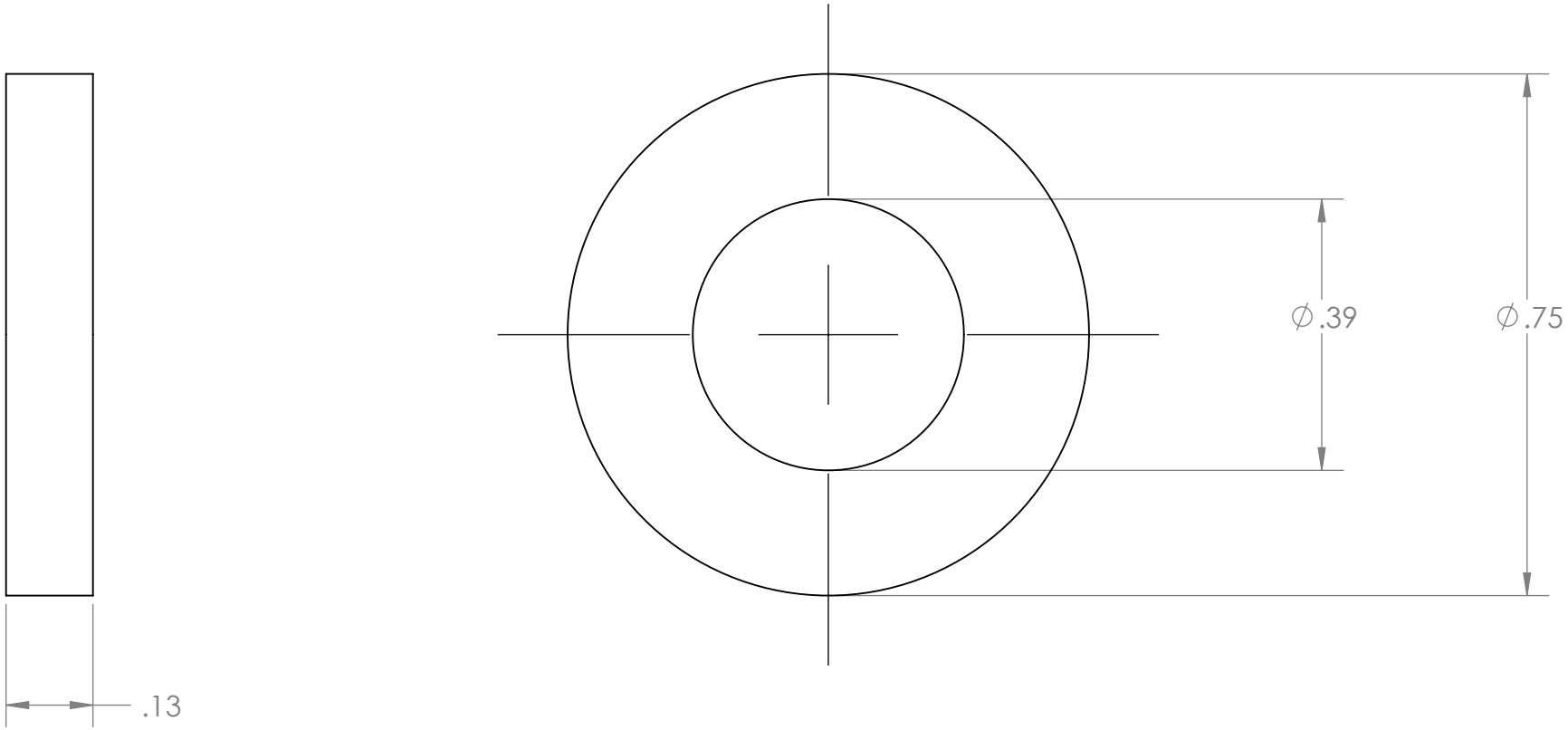

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Lock-ring of Dust protector for injection port

SIZE	DWG. NO.	REV
A	Funnel_lock_ring	
SCALE: 4:1	WEIGHT:	SHEET 1 OF 1

5 4 3 2 1

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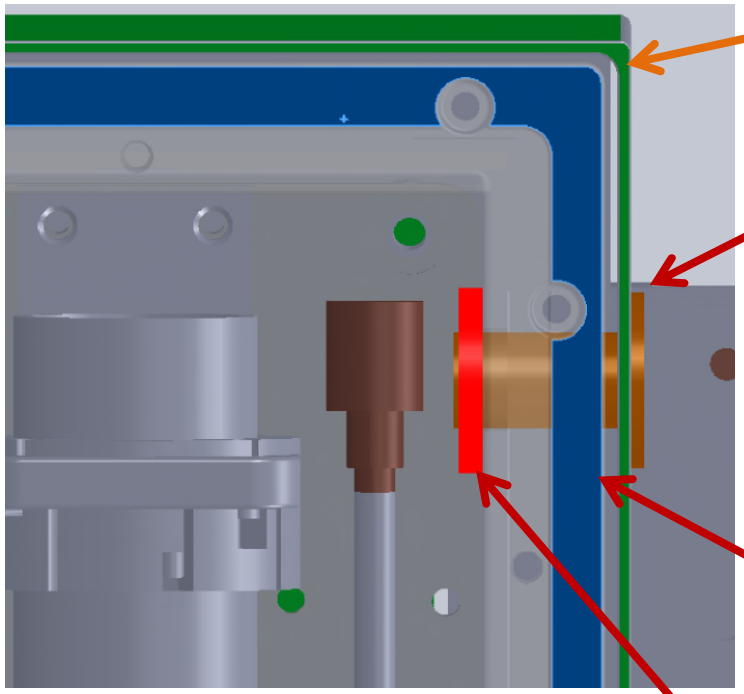
Sealing Assembly at -30 °C Exit Port



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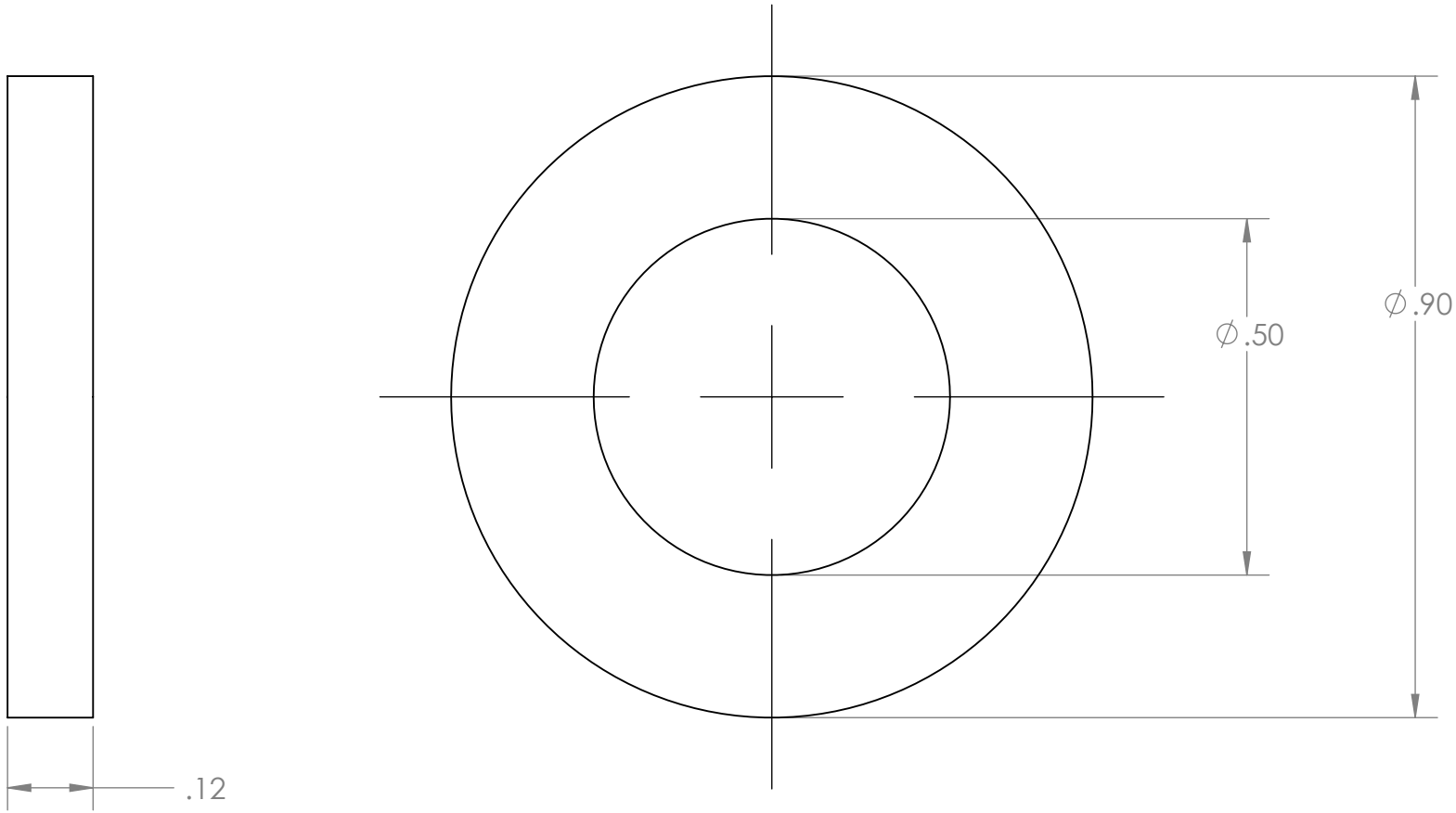

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Exit port sealing washer

SIZE	DWG. NO.	REV
B	Exit port washer	

SCALE: 4:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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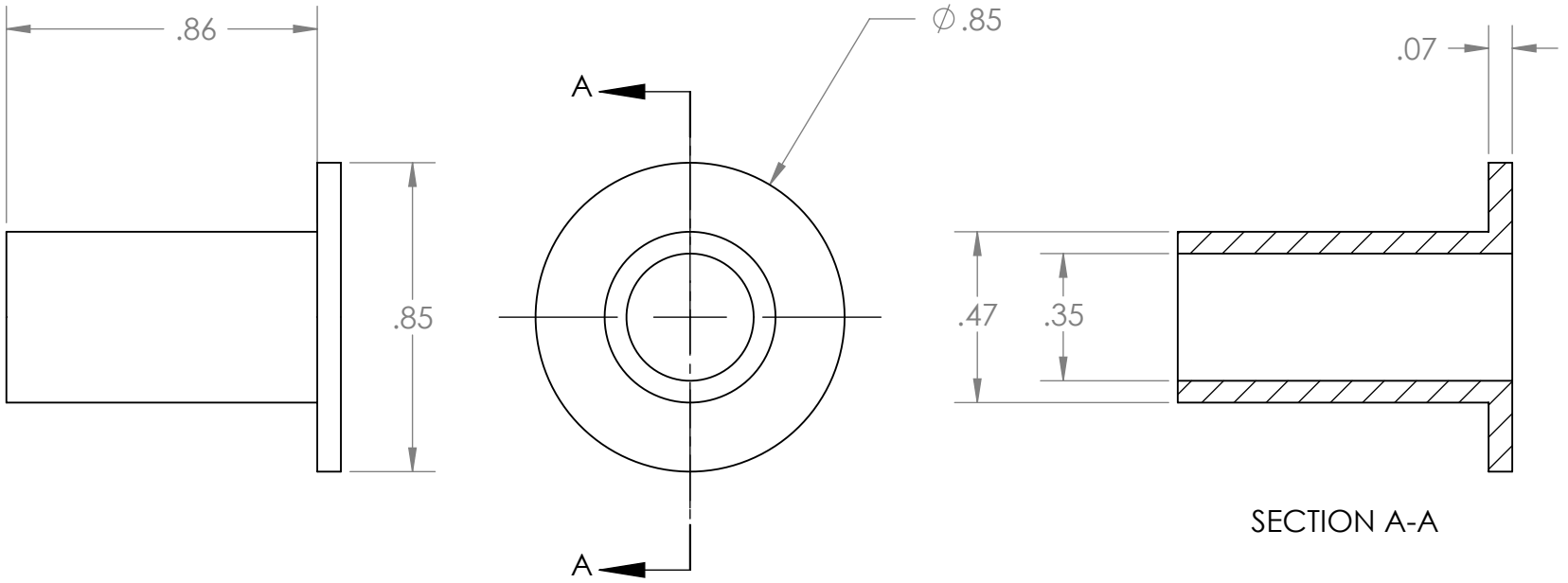

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

Cold Chamber exit tube

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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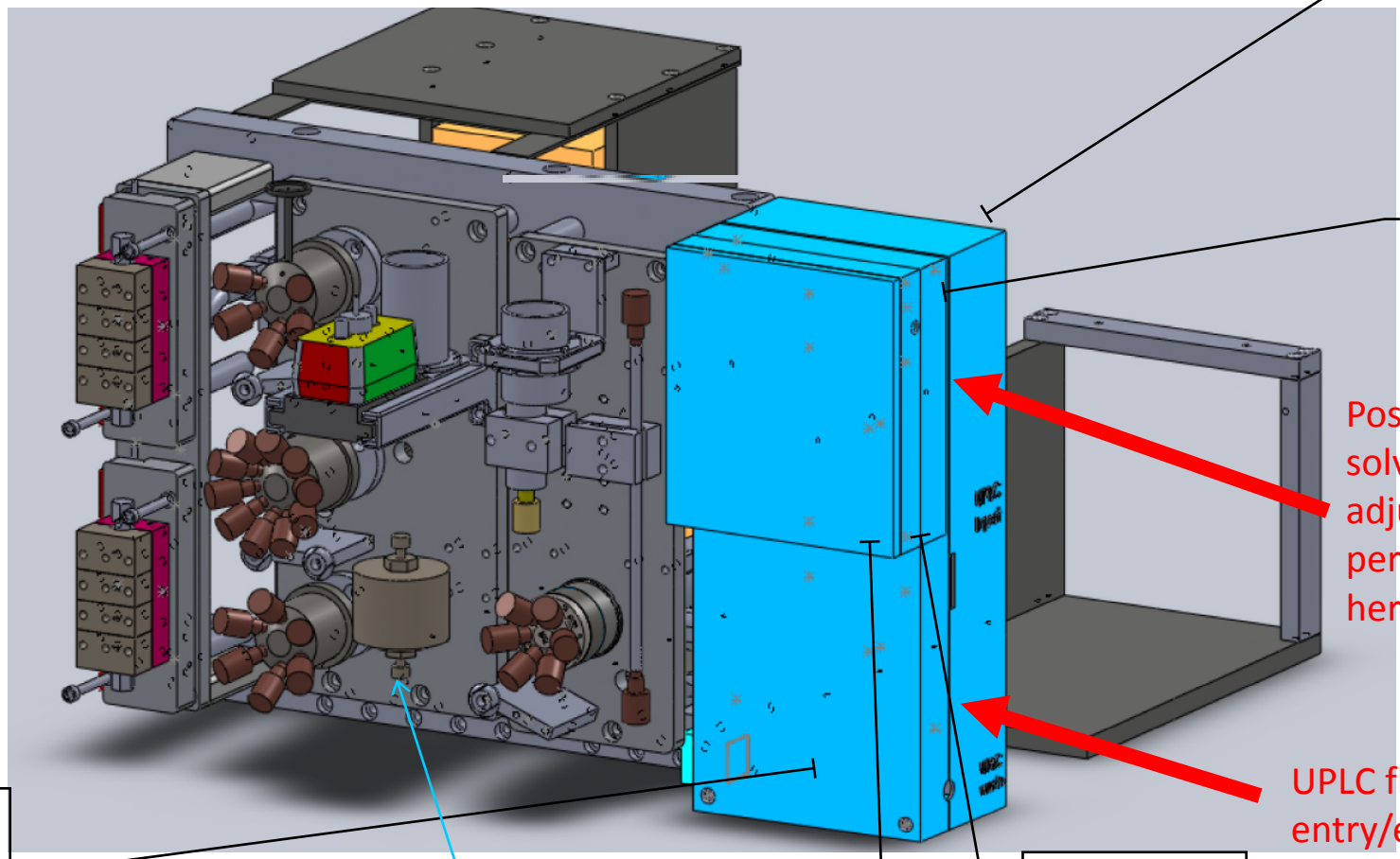
Populated Internal Frame (STL File Directory)

(Entire assembly slides into box as one piece)



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STL Catalog Housing for NIST HPLC, part 1

Backside housing top metal (left--back).SLDPRT

Backside housing top metal (left--back).STL

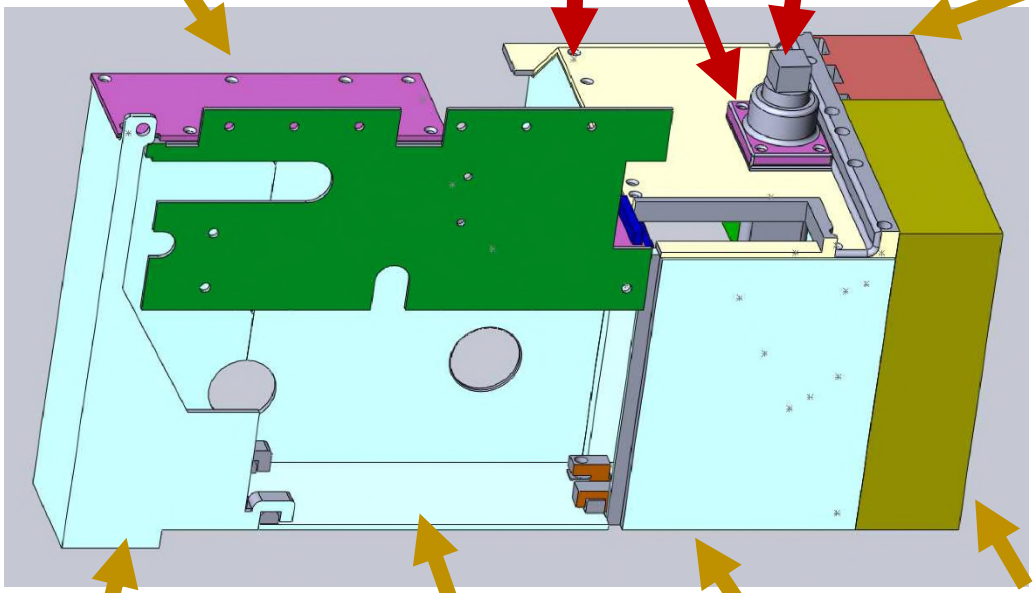
Valve adjust sleeve.STL

thotler valve driver.SLDPRT (Adjust with Wrench.STL)

Side Cover.SLDPRT

Housing Installation:

1) Start with no components on “motor rail base”
2) Install "Shell-back metal.STL“ (Screw holes are also provide to flatten panel against aluminum extrusions.)
3) Install "Backside housing (left-3a).STL" and "Backside housing metal (left-2).STL“
4) Push "Backside housing metal2 (left-1).SLDPRT" along the assembly in #3 to directly engage the clamp. The assembly may be further stabilized with a 6-32 cap-head screw.
5) Push "Backside housing (right).SLDPRT" in high to allow clamps to engage with "Backside housing metal2 (left-1).SLDPRT". (You may want to rotate this into place.) Affix to Al frame using a single 8-32 screw.



Backside housing (left-4).STL

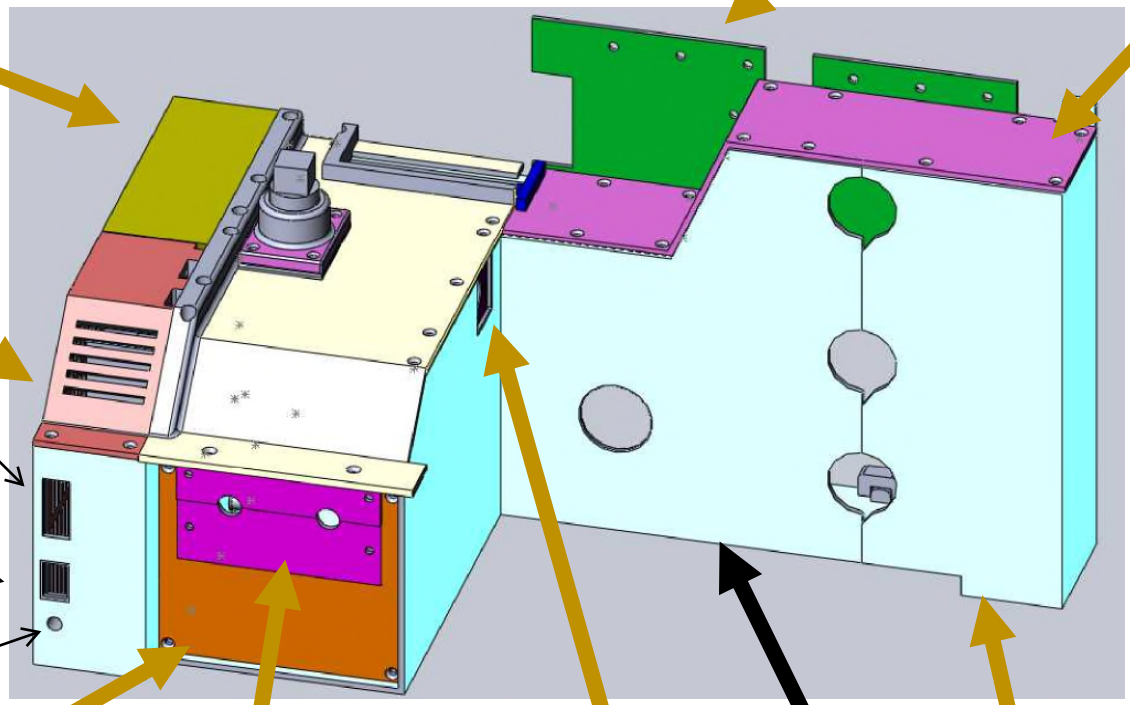
Backside housing metal2 (left-1).STL

Backside housing metal (left-2).SLDPRT

Hooks are engaged by rotating “Backside housing (Right).STL” into position.

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

STL Catalog Housing for NIST HPLC, part 2



Shell-Backmetal.STL

Cover right metal.STL

Side Cover protecting RTDs

Cover over PS's & 110 VAC components

This is the original design. A design that is more convenient during site placement of the apparatus is shown on next slide. It features a detachable power cord.

Backside housing (left-3a).STL

Power Entry is simply a cord that is constrained from removal by two zip-ties mounted on the cord just inside the box.

Cryo-bulkhead

Cryobulkhead (Variations of plumbing will Require users to design their own feedthrus.)

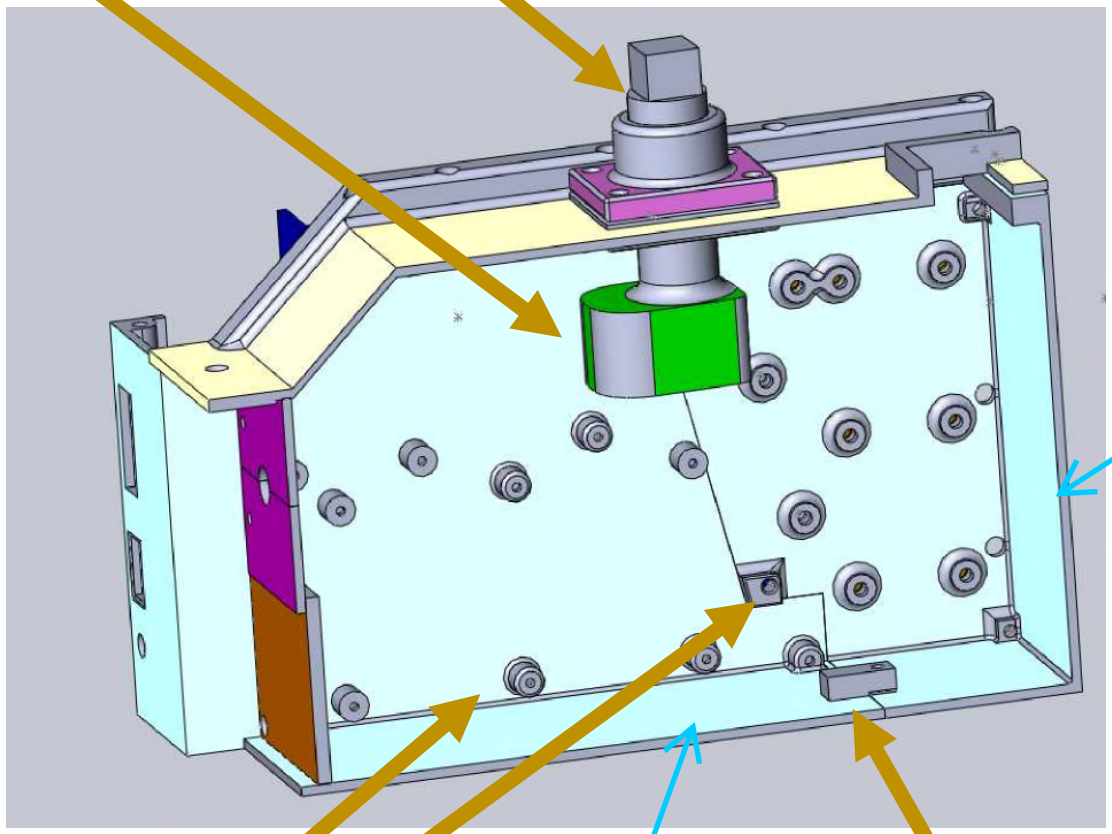
"Aux Heater adapter.STL" (Aux cable connecter Is located here.)

Backside housing (Right).STL

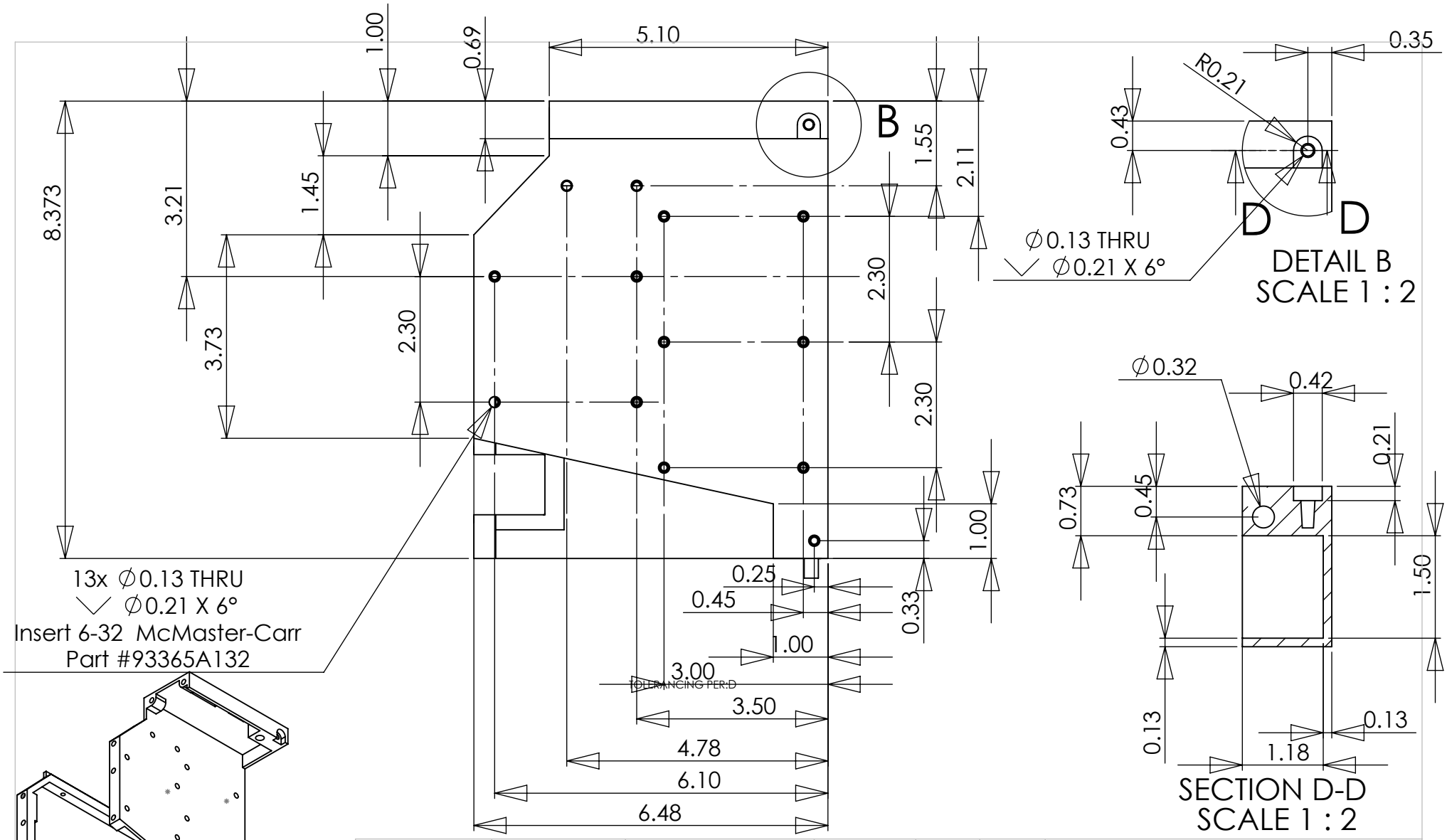
Backside housing metal2 (left-1).STL

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Cut-away of Housing Near Coolant Mixing Zone



Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



NOTE: This design is the original implementation; however, I recommend using "Backside housing left (alt-design)" shown below.

			NAME	DATE
		ENG APPR.C		
		MFG APPR.		
		Q.A.		
		COMMENTS:		
NEXT ASSY	USED ON			
APPLICATION		DO NOT SCALE DRAWING		

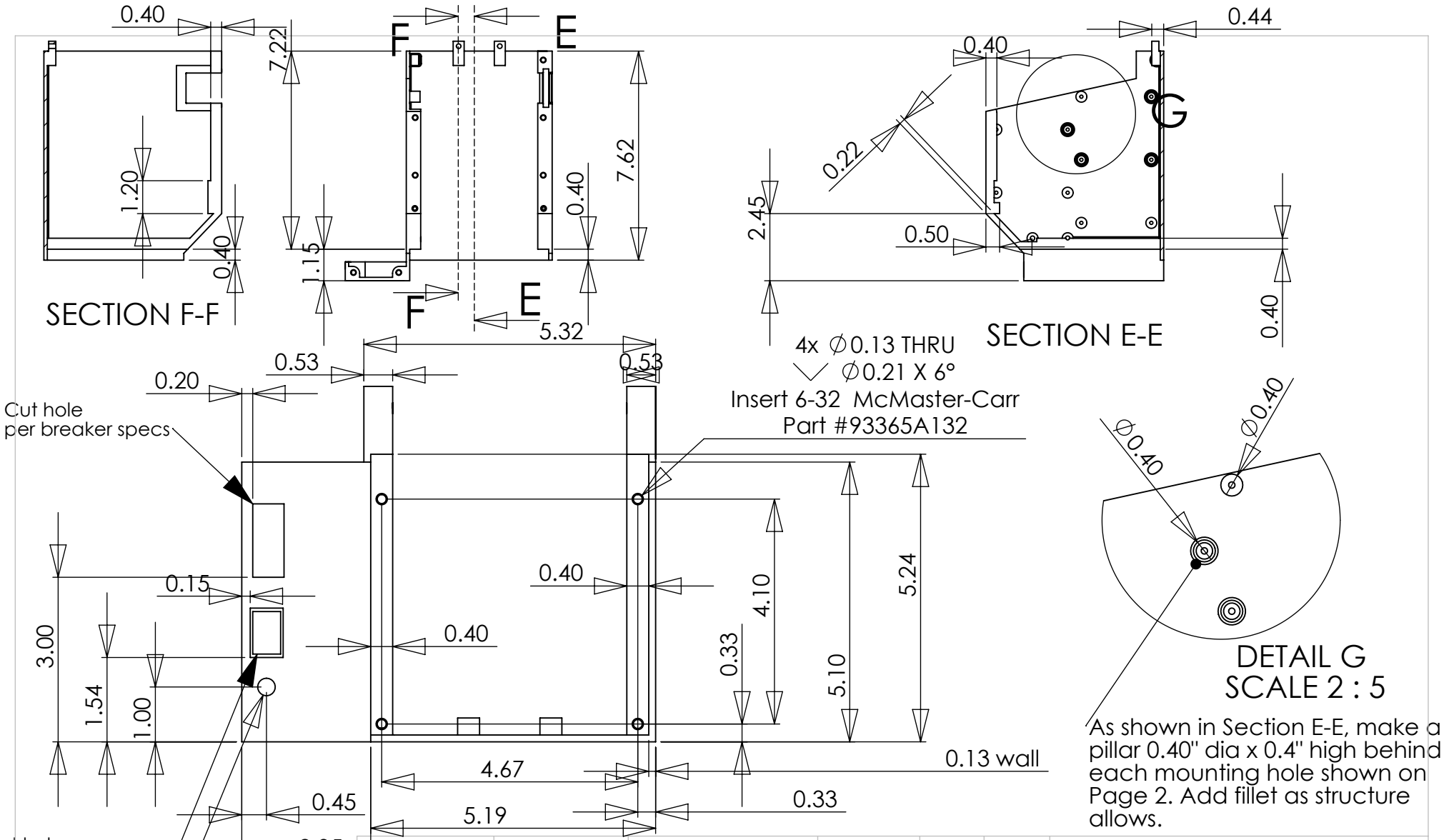
TITLE: Backside metal left (1 of 6)

SIZE	DWG. NO.	REV
A		

SCALE: 1:5 WEIGHT: SHEET 1 OF 6

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

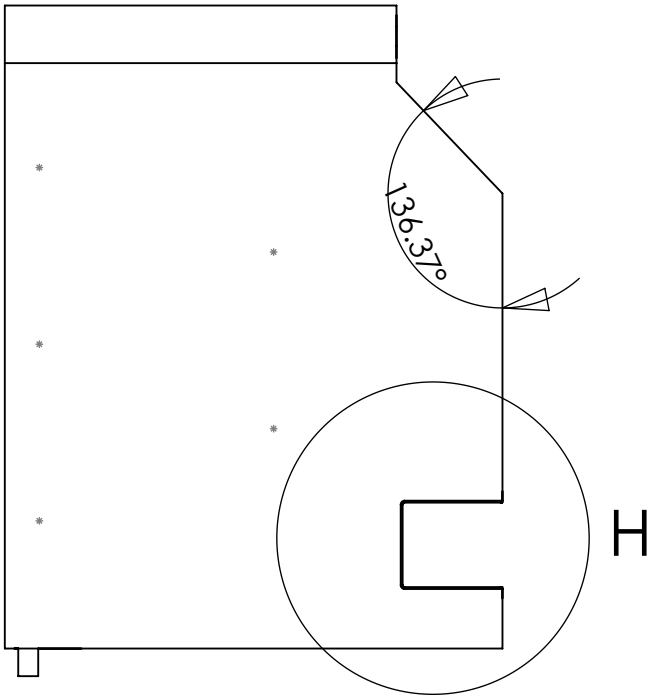
TITLE: Backside metal left (2 of 6)

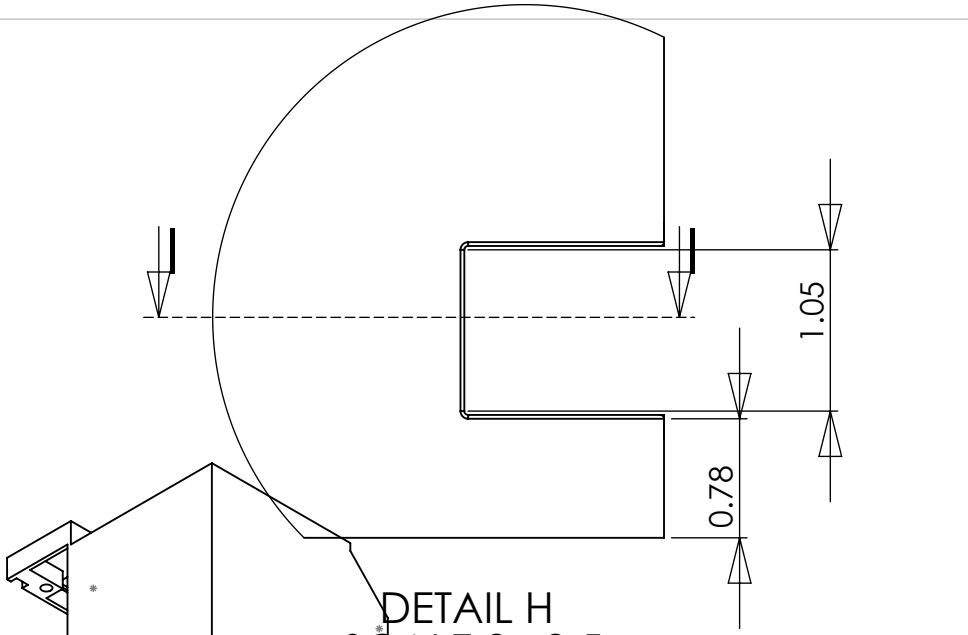
SIZE	DWG. NO.	REV
A		

SCALE: 1:5 WEIGHT: SHEET 2 OF 6

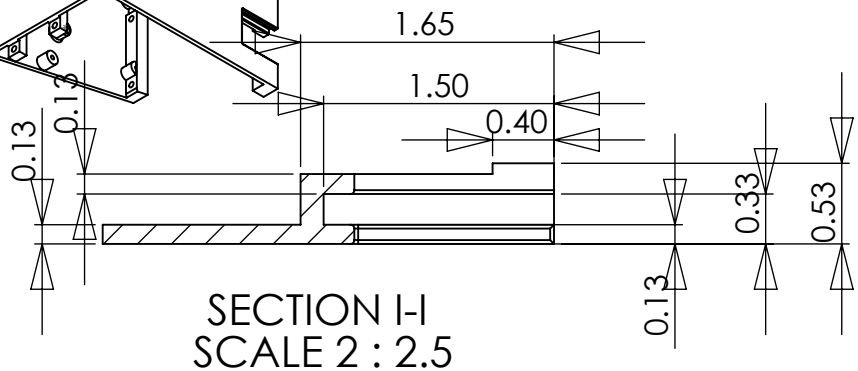
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





DETAIL H
SCALE 2 : 2.5



SECTION I-I
SCALE 2 : 2.5

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

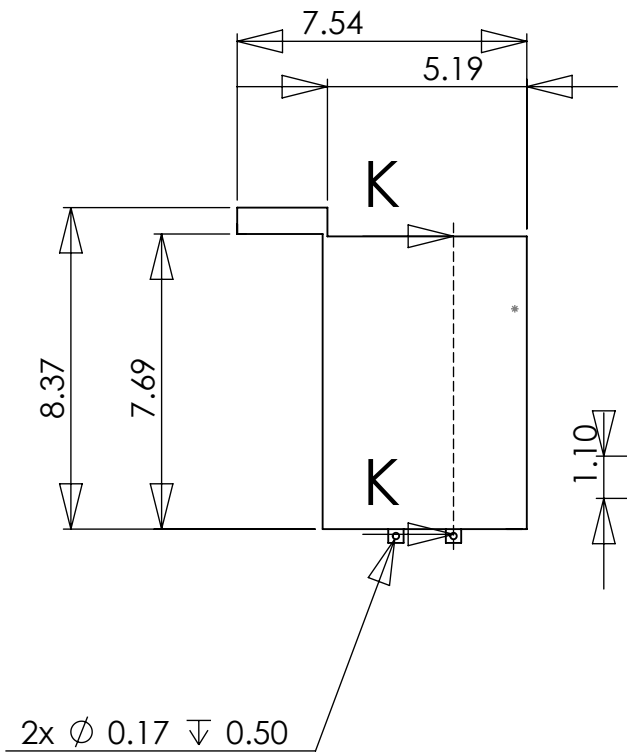
TITLE: Backside metal left (3 of 6)

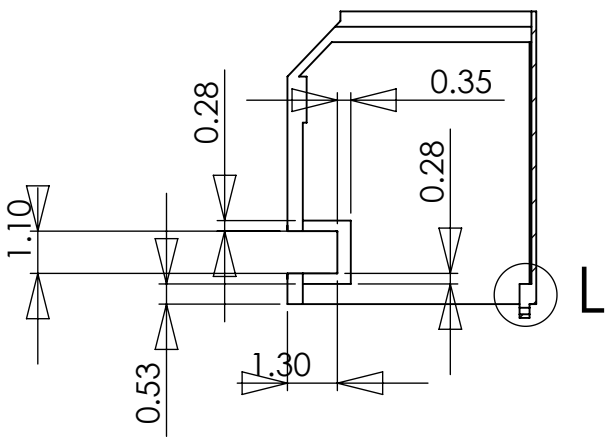
SIZE	DWG. NO.	REV
A		

SCALE: 1:5 WEIGHT: SHEET 3 OF 6

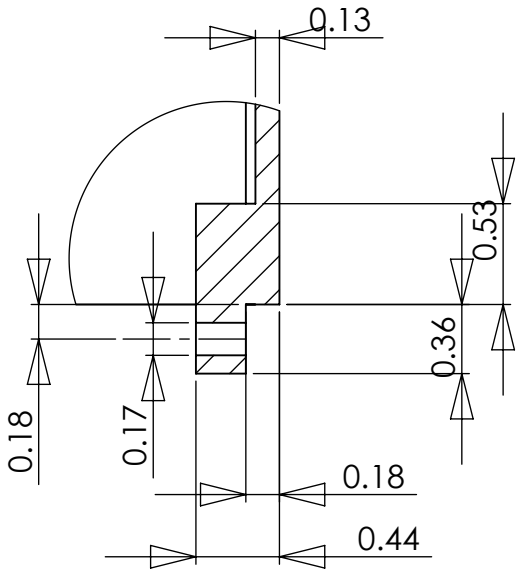
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





SECTION K-K



DETAIL L
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH	.)		
APPLICATION		DO NOT SCALE DRAWING			

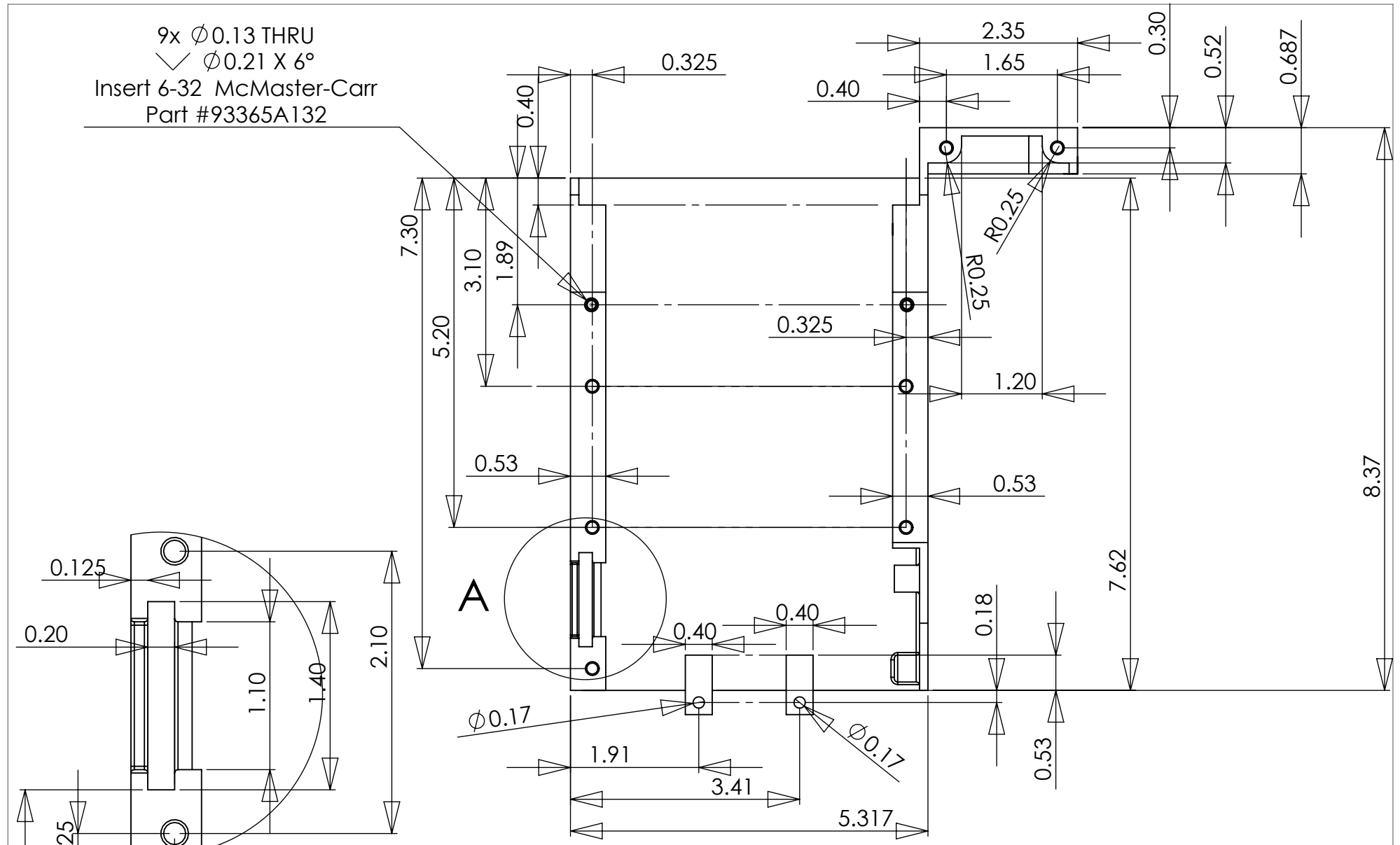
TITLE:
Backside metal left (4 of 6)

SIZE	DWG. NO.	REV
A		

SCALE: 1:5 | WEIGHT: | SHEET 4 OF 6

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



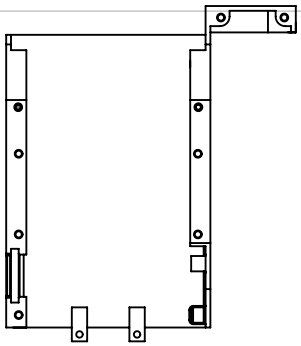
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
			COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

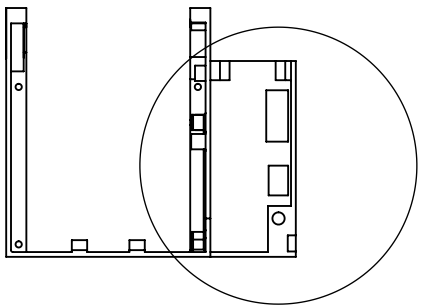
<COMPANY NAME>

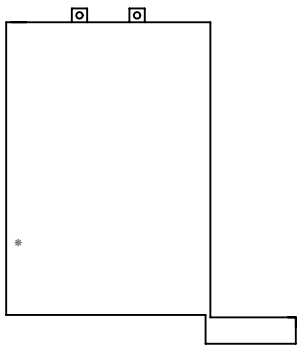
Backside metal left (5 of 6)

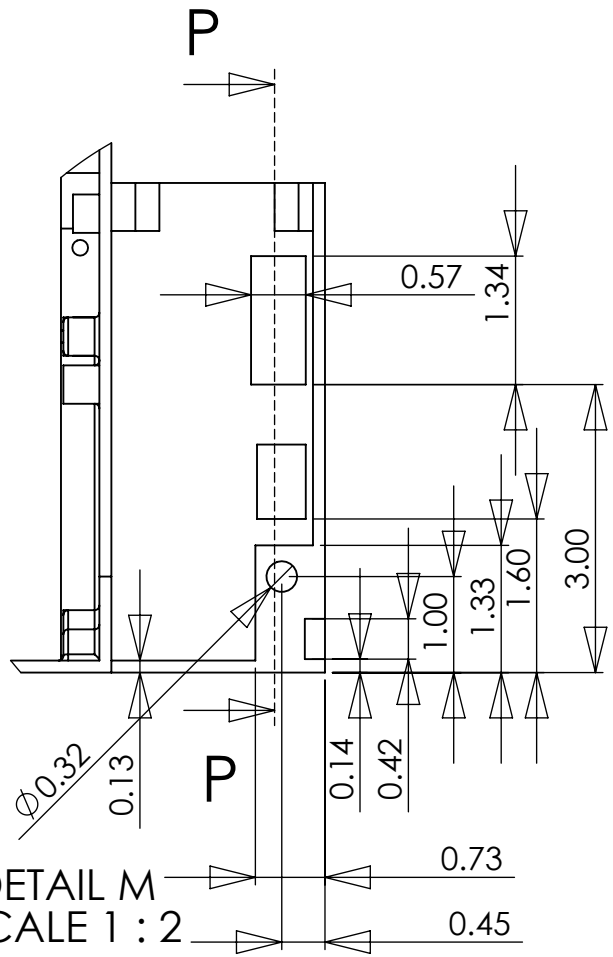
SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 5 OF 6

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

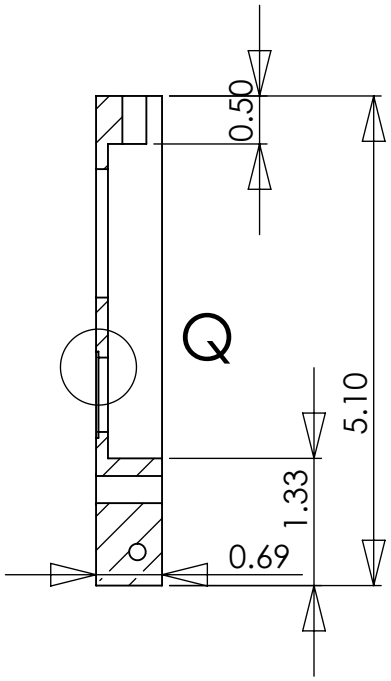




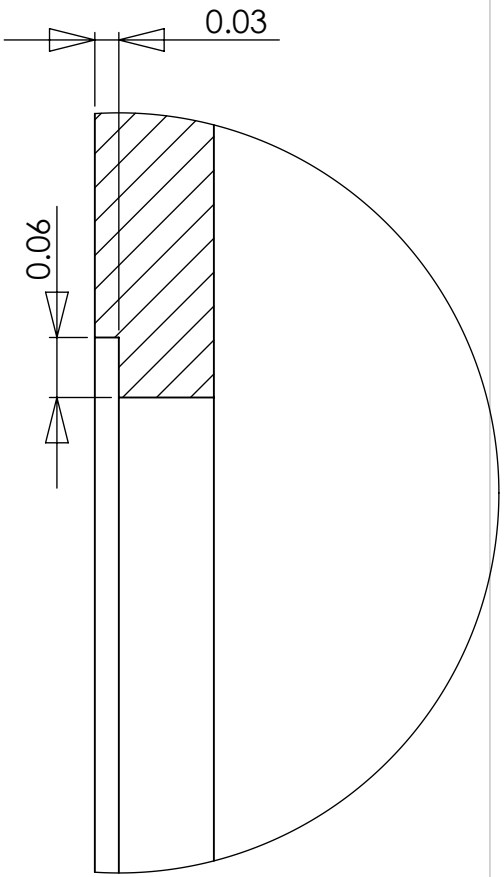




DETAIL M
SCALE 1 : 2



SECTION P-P
SCALE 1 : 2



DETAIL Q
SCALE 5 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE: Backside metal left (6 of 6)

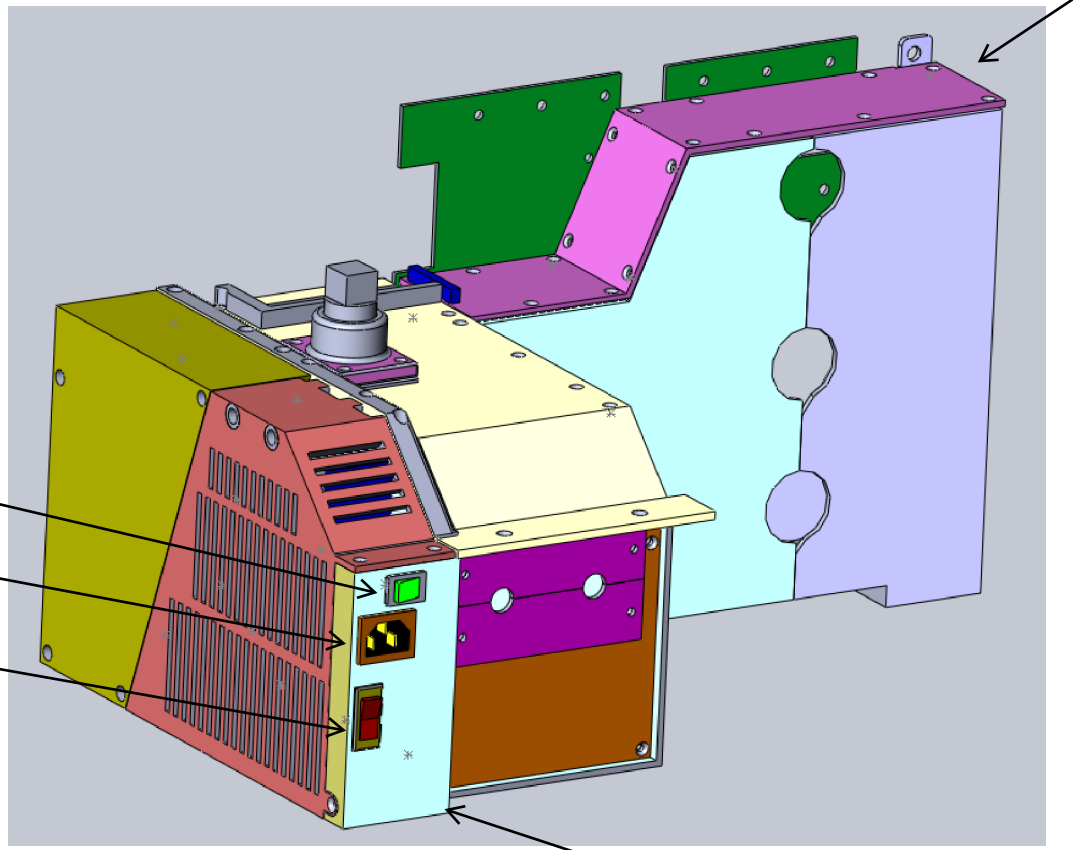
SIZE	DWG. NO.	REV
A		

SCALE: 1:5 WEIGHT: SHEET 6 OF 6

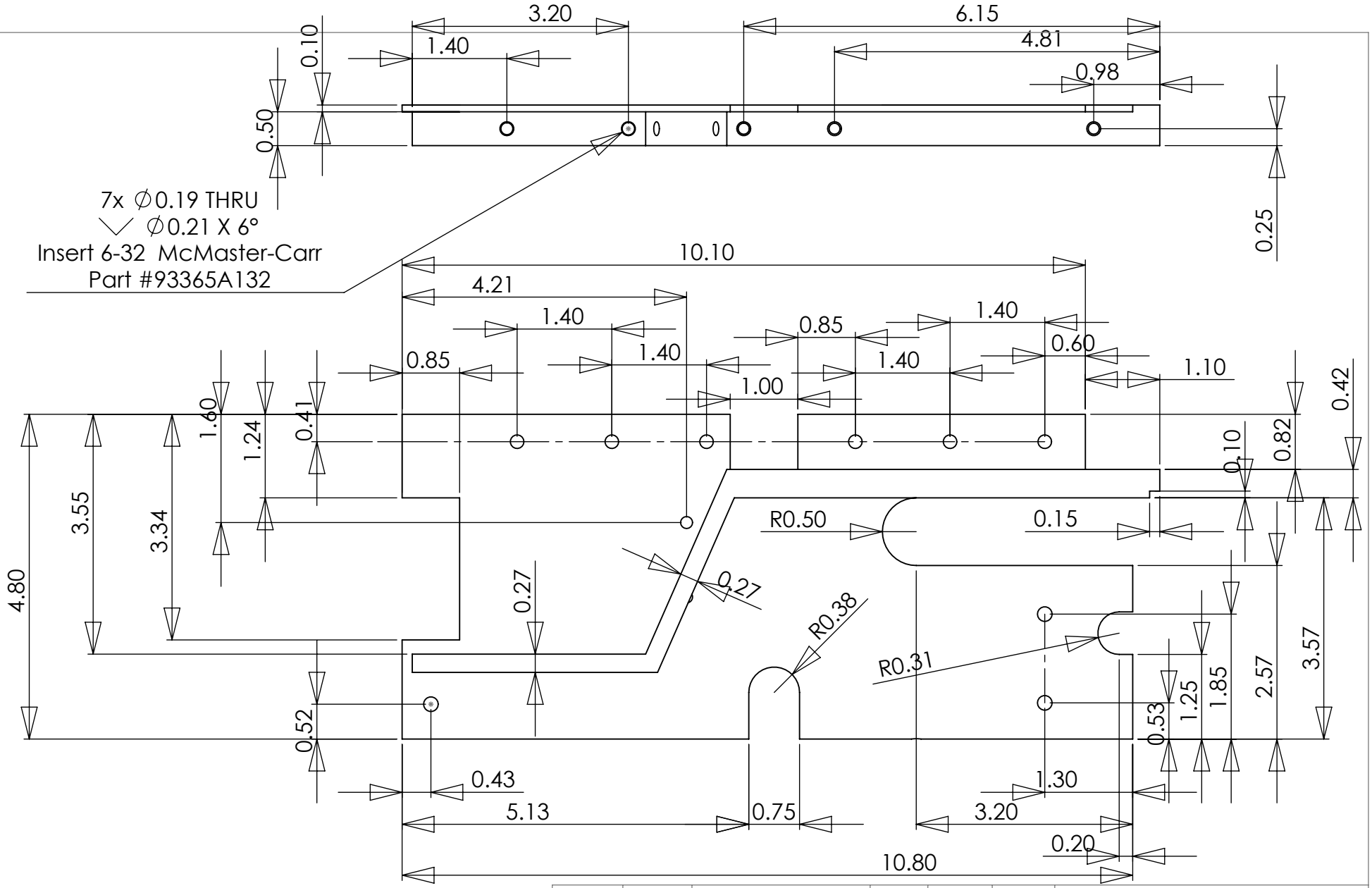
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Backside Housing Showing Newer Power Entry



Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



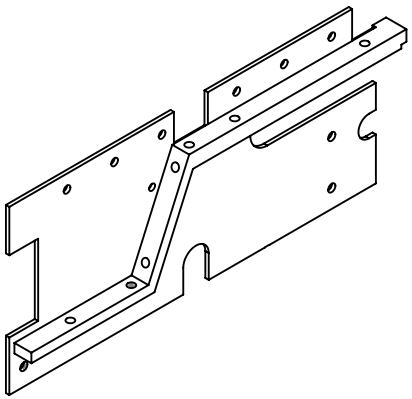
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME / DATE
			DRAWN	
			CHECKED	
			ENG APPR.	
			MFG APPR.	
			Q.A.	
			COMMENTS:	
NEXT ASSY	USED ON	MATERIAL --		
		FINISH --		
APPLICATION		DO NOT SCALE DRAWING		

3D Print in PLA

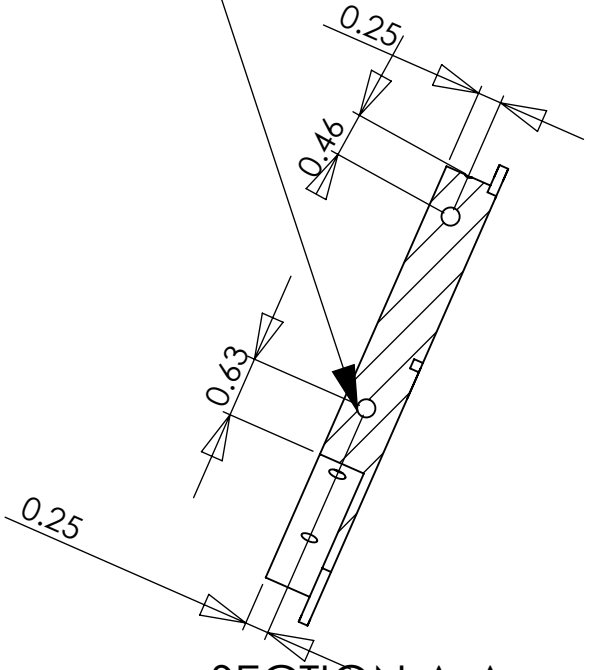
Shell-back metal (p. 1 of 2)

SIZE	DWG. NO.	REV.
A		
SCALE:1:2	WEIGHT:	SHEET 1 OF 2

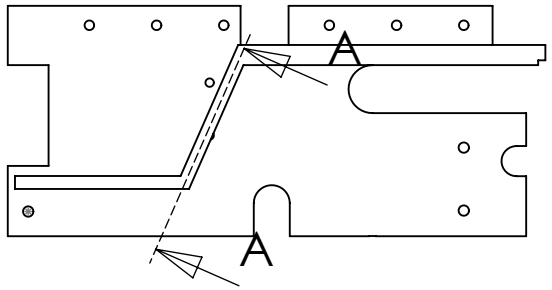
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



2x ⌀0.19 THRU
⌵ ⌀0.206 X 6°
Insert 6-32 McMaster-Carr
Part #93365A132



SECTION A-A



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

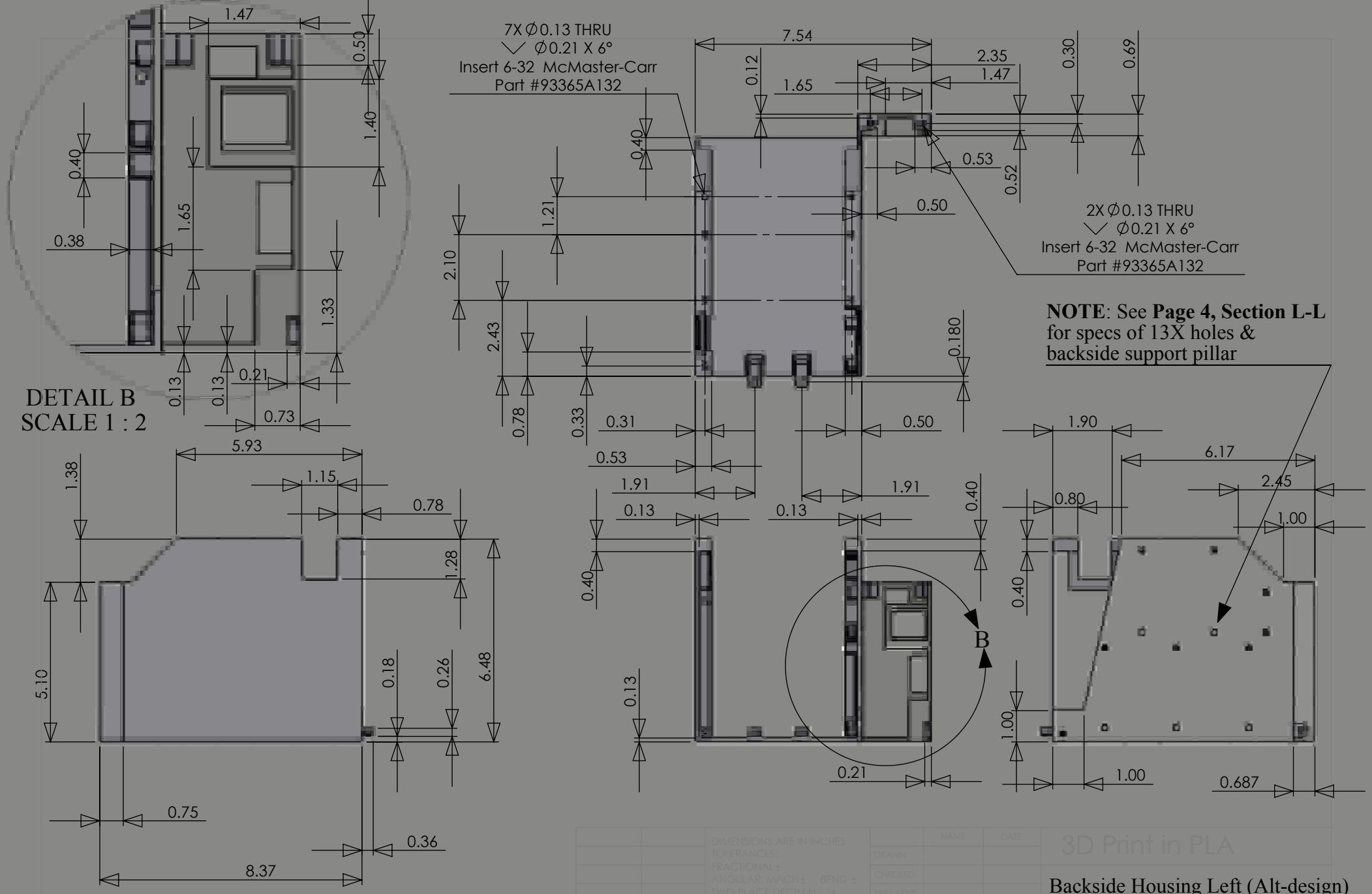
TITLE: Shell-back metal (p. 2 of 2)

SIZE	DWG. NO.	REV
.A		

SCALE: 1:2 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

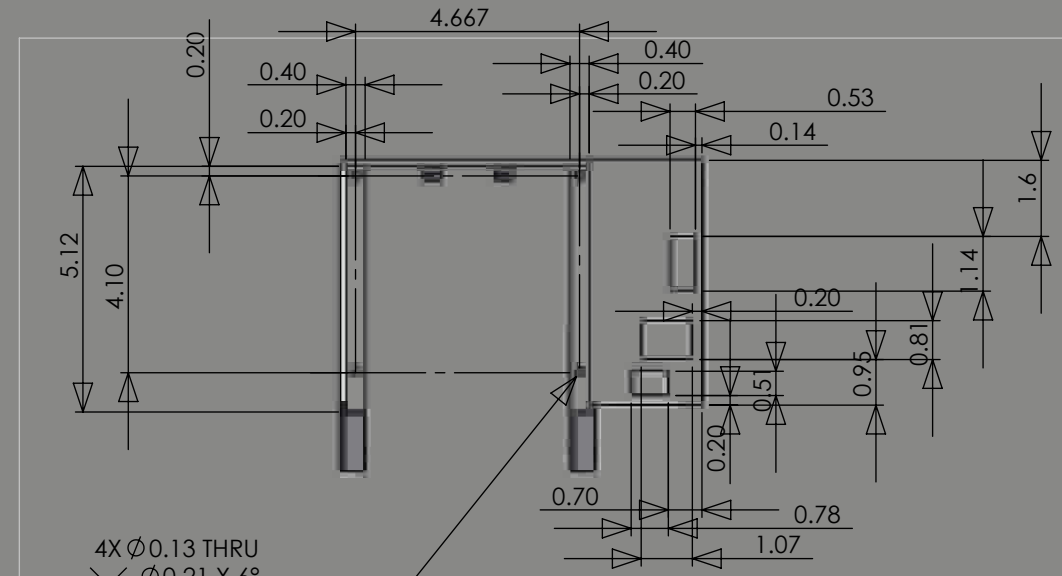


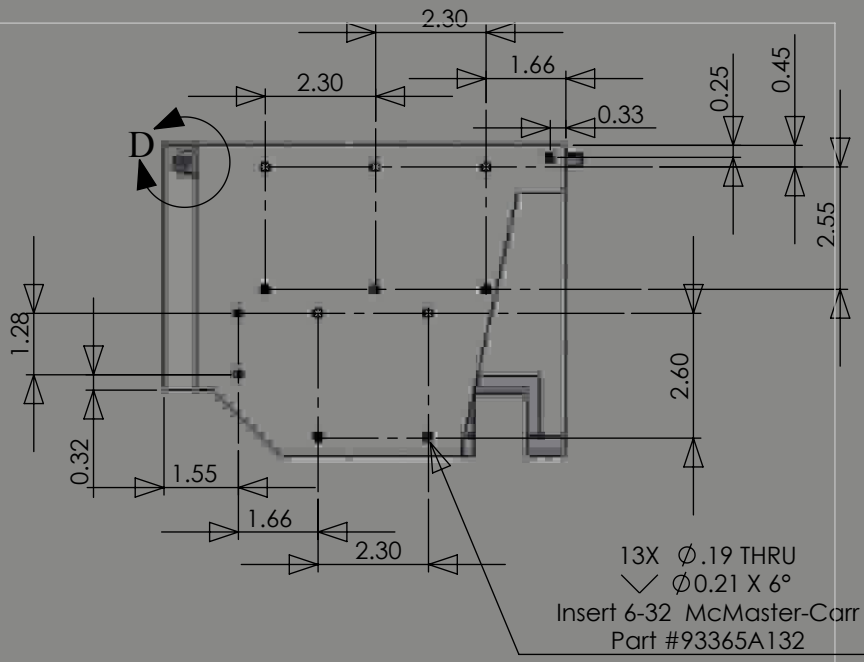
NOTE: See **Page 4, Section L-L** for specs of 13X holes & backside support pillar

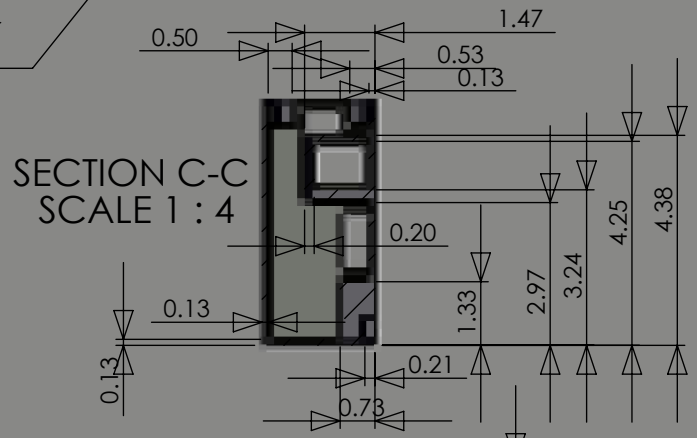
3D Print in PLA

Backside Housing Left (Alt-design)
(page 1 of 4)

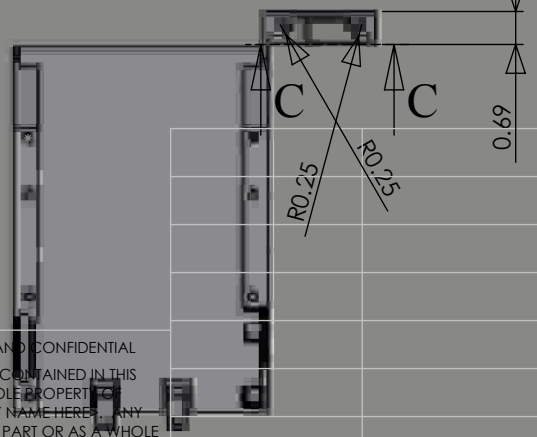
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

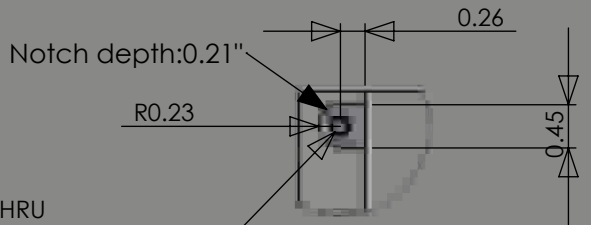






SECTION C-C
SCALE 1 : 4





∅.19 THRU
∅0.16 X 6°
Insert 6-32 McMaster-Carr
Part #93365A132

DETAIL D
SCALE 1 : 2

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

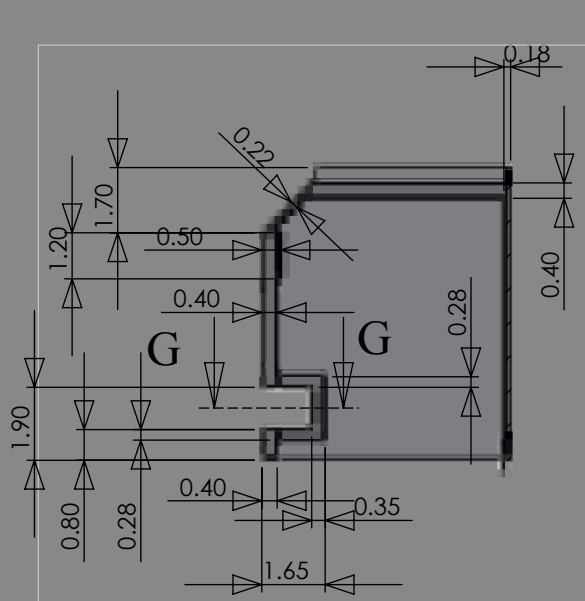
TITLE:
Backside Housing Left (Alt-design)
(page 2 of 4)

SIZE	DWG. NO.	REV
A		

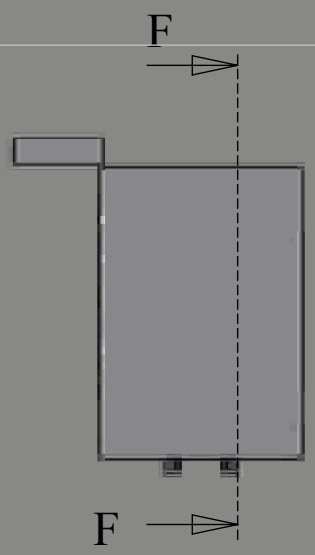
SCALE: 1:5 | WEIGHT: | SHEET 2 OF 4

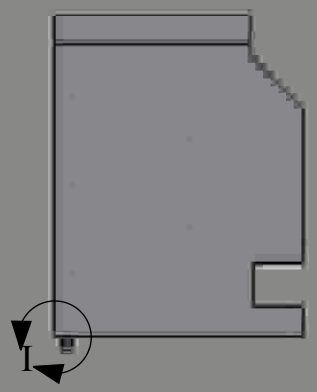
5 4 3 2 1

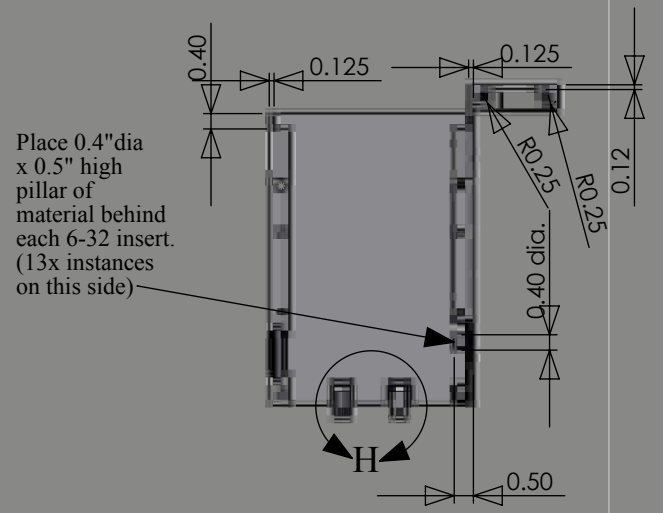
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

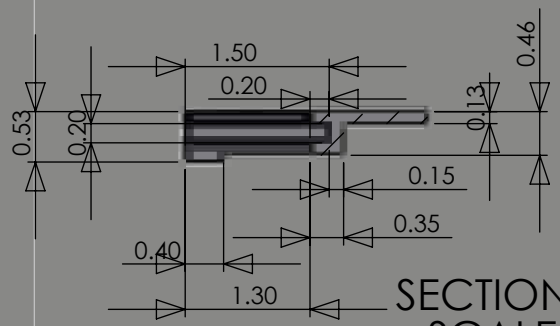


SECTION F-F

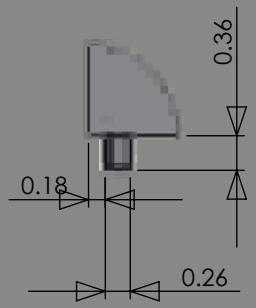




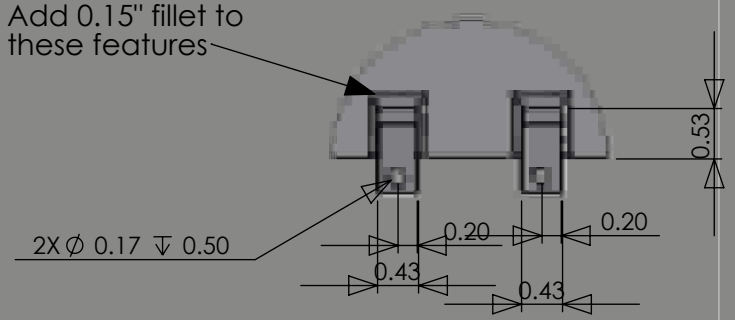




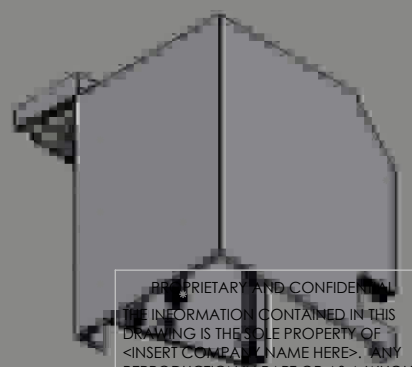
SECTION G-G
SCALE 1 : 2



DETAIL I
SCALE 1 : 2



DETAIL H
SCALE 1 : 2



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH	•		
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

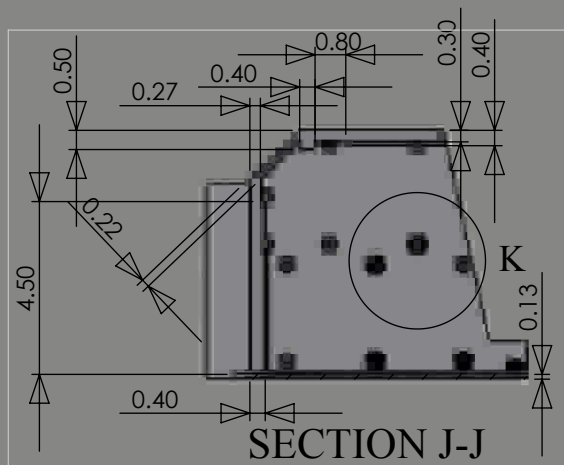
Backside Housing Left (Alt-design) (page 3 of 4)

SIZE	DWG. NO.	REV
A		

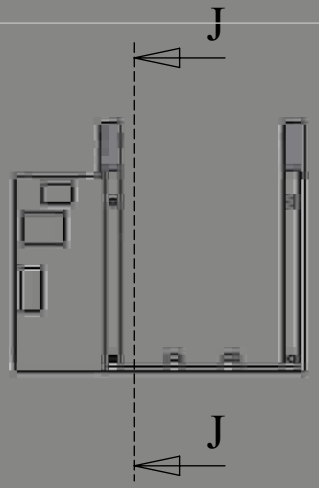
SCALE: 1:5 WEIGHT: SHEET 3 OF 4

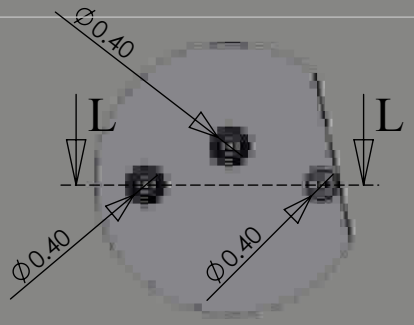
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



SECTION J-J

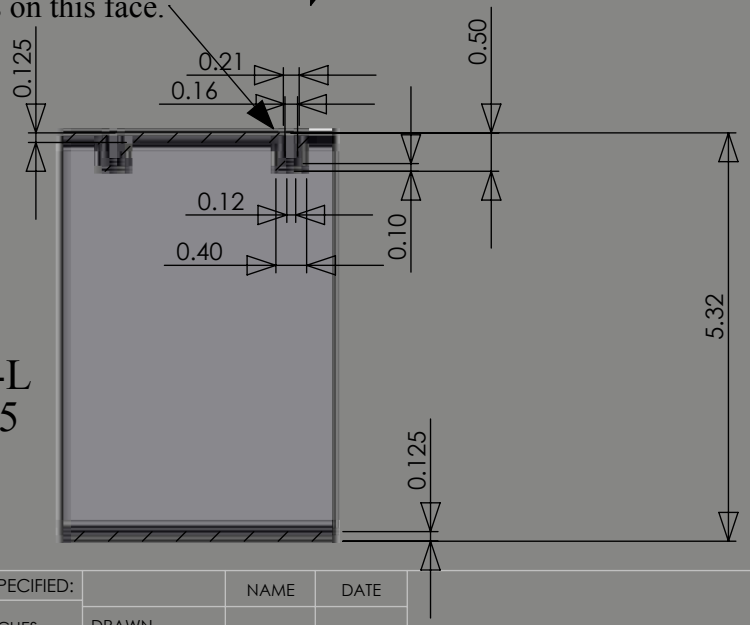




DETAIL K
SCALE 2 : 5

13X ⌀0.13 THRU
⌵ ⌀0.206 X 6°; Depth: 0.40"
Insert 6-32 McMaster-Carr
Part #93365A132

NOTE: This feature is behind each of the 13X holes on this face.



SECTION L-L
SCALE 2 : 5

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH	•		
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

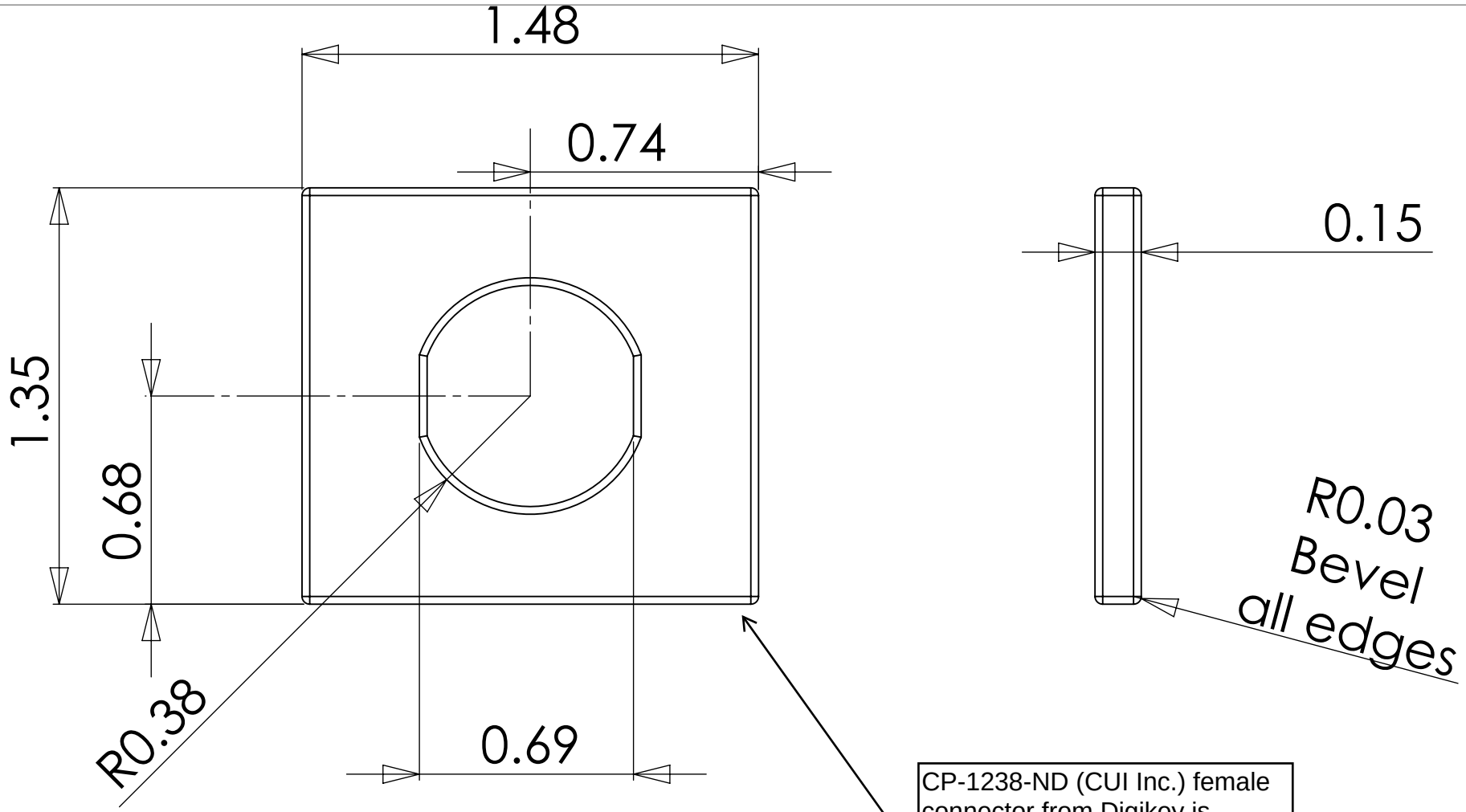
Backside Housing Left (Alt-design)
(page 4 of 4)

SIZE	DWG. NO.	REV
A		

SCALE: 1:5 | WEIGHT: | SHEET 4 OF 4

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



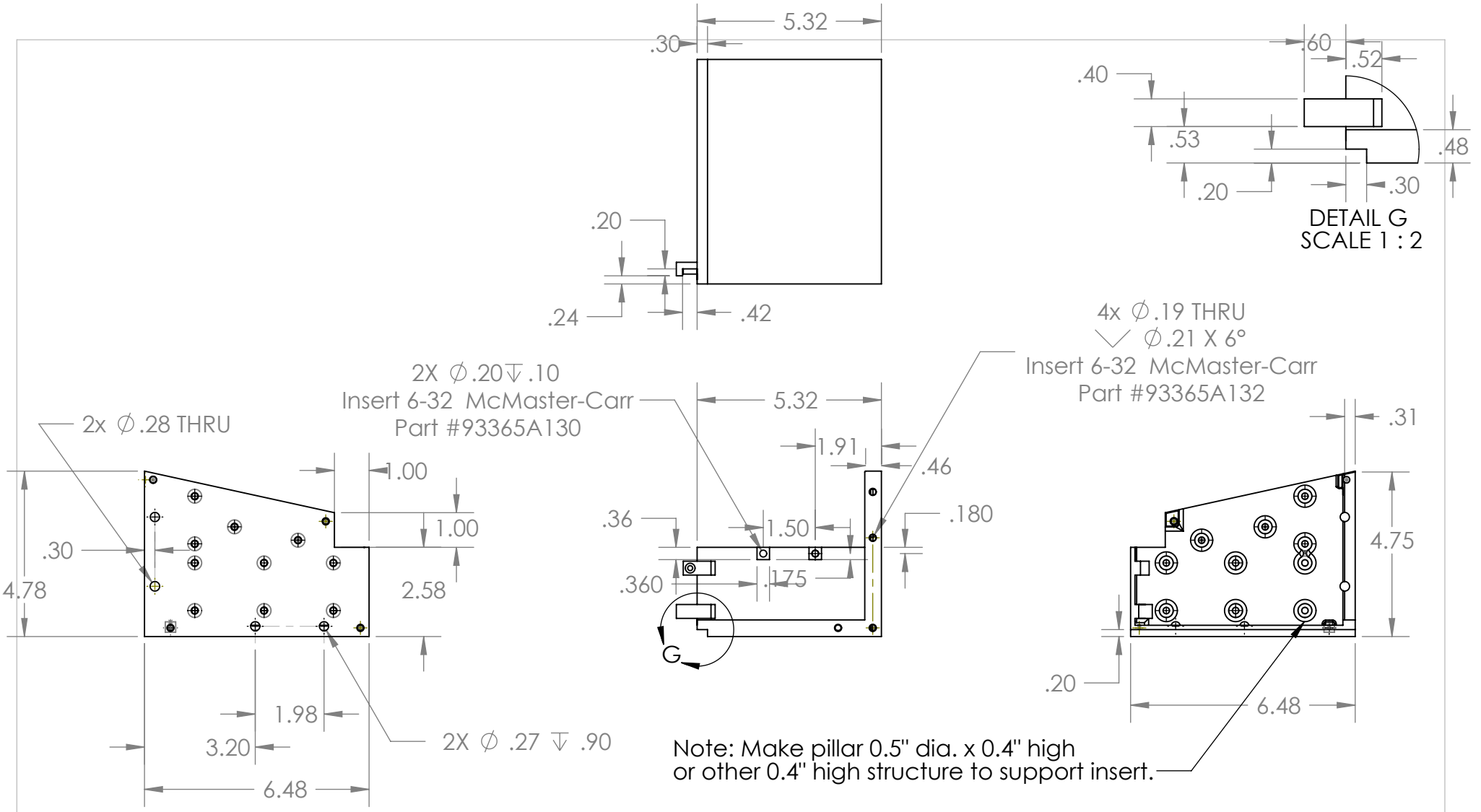
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
			COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

Aux Heater adapter

SIZE	DWG. NO.	REV.
A		
SCALE:2:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



NOTE: See page 2
for locations of other
holes on this face.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print PLA

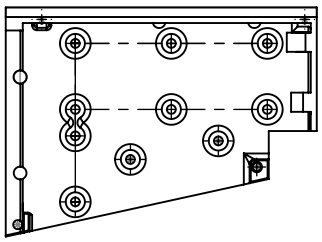
TITLE:
Backside housing 2
(page 1 of 3)

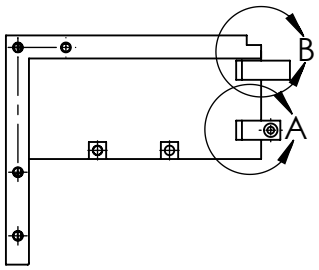
SIZE	DWG. NO.	REV
A		

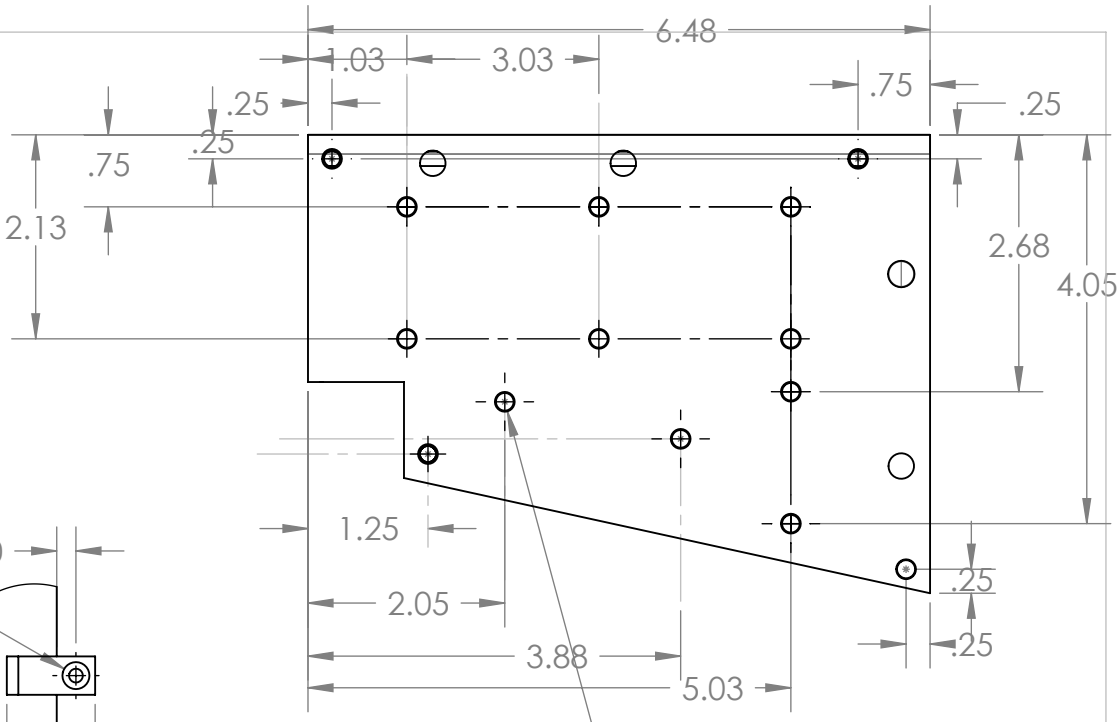
SCALE: 1:4 WEIGHT: SHEET 1 OF 3

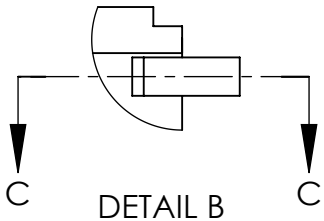
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

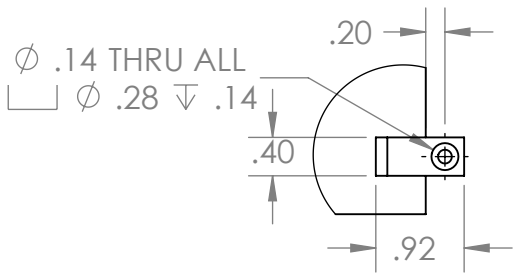




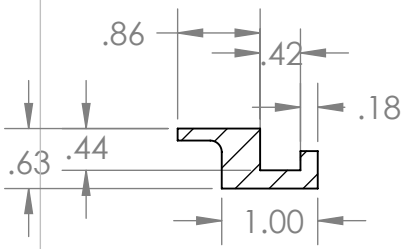




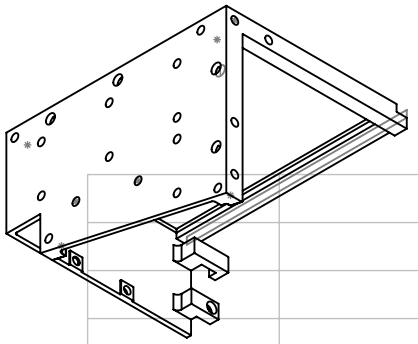
DETAIL B
SCALE 1 : 2



DETAIL A
SCALE 1 : 2



SECTION C-C
SCALE 1 : 2



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		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

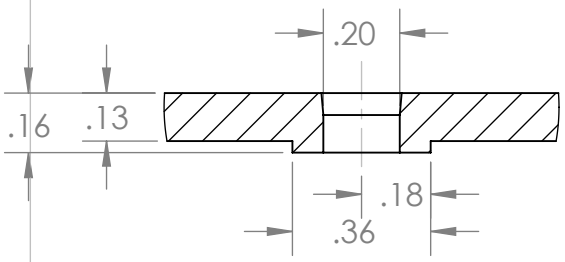
TITLE:
Backside housing 2 (page 2 of 3)

SIZE	DWG. NO.	REV
A		

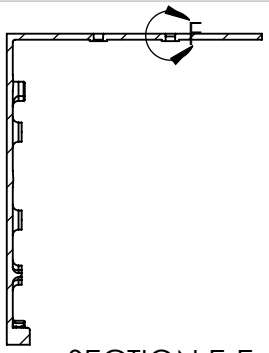
SCALE: 1:4 WEIGHT: SHEET 2 OF 3

5 4 3 2 1

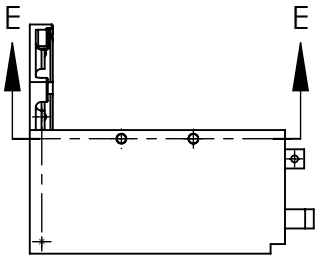
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

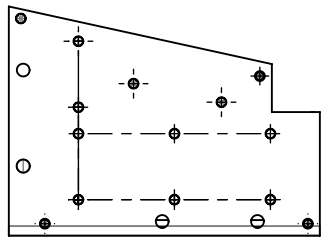


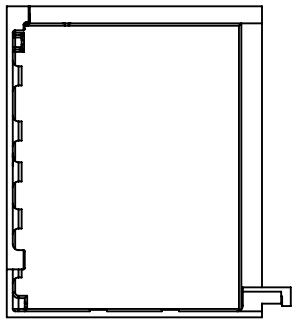
DETAIL F
SCALE 2 : 1



SECTION E-E







		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

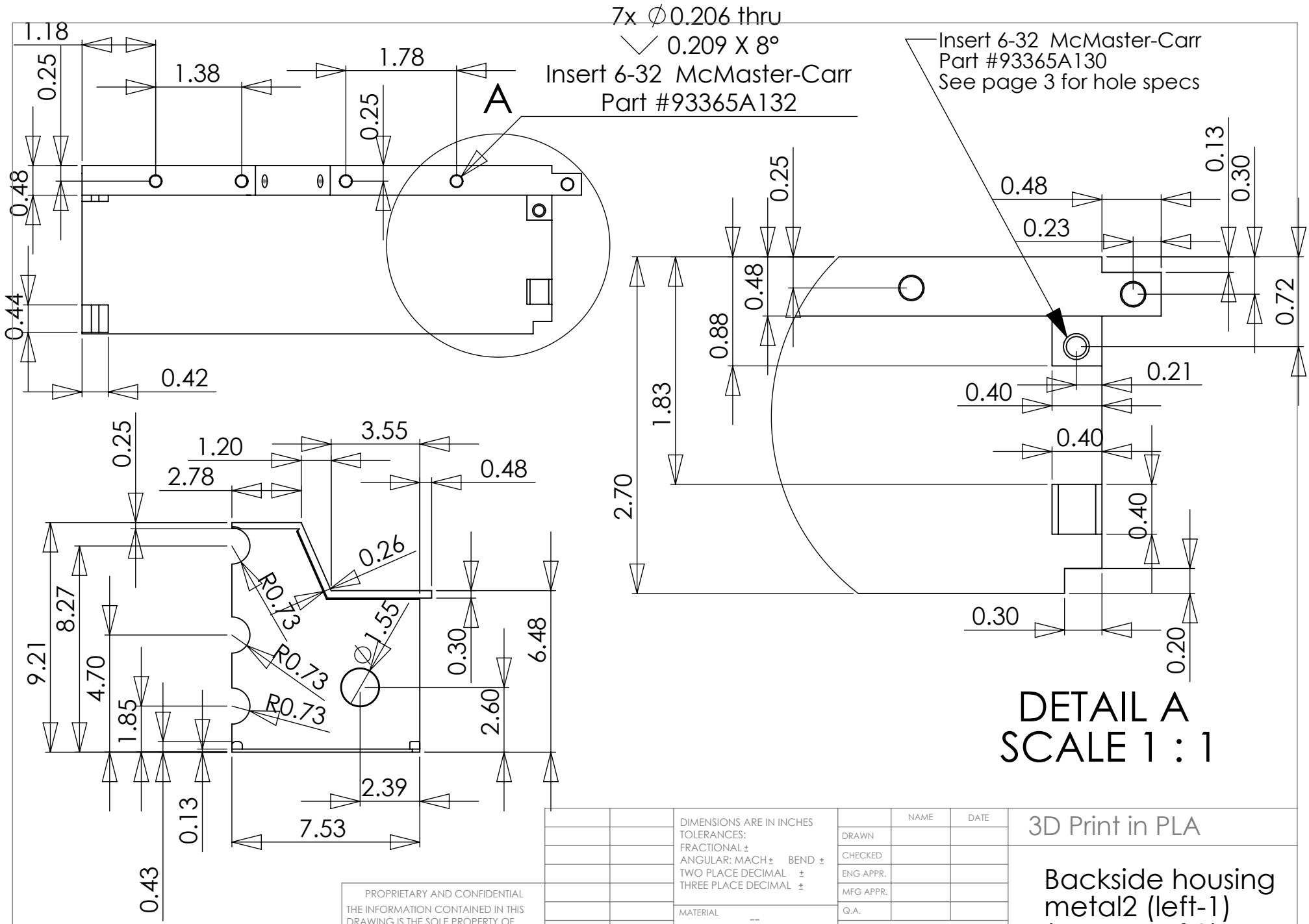
TITLE: Backside housing 2 (page 3 of 3)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 3 OF 3

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



DETAIL A
SCALE 1 : 1

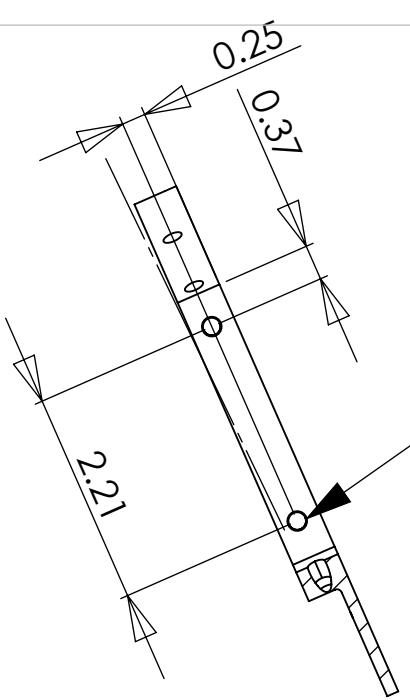
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME / DATE
		MATERIAL --	DRAWN	
		FINISH --	CHECKED	
NEXT ASSY	USED ON		ENG APPR.	
APPLICATION		DO NOT SCALE DRAWING	MFG APPR.	
			Q.A.	
			COMMENTS:	

3D Print in PLA

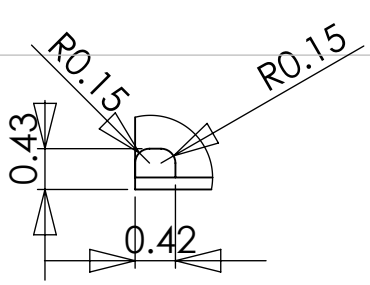
Backside housing metal2 (left-1) (page 1 of 3)

SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 1 OF 3

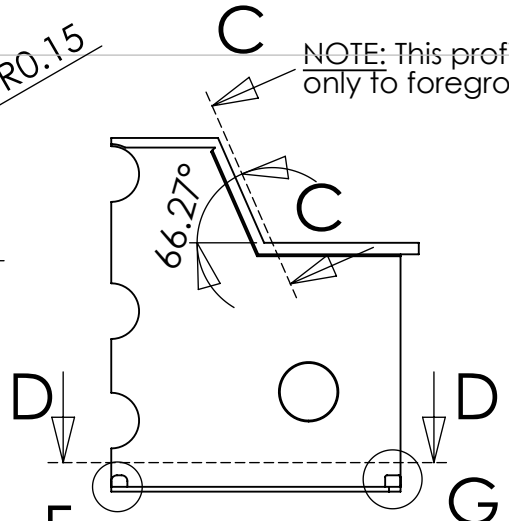
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

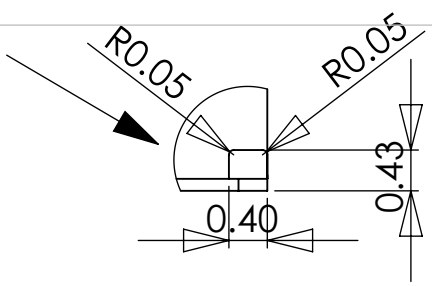


SECTION C-C
SCALE 1 : 2

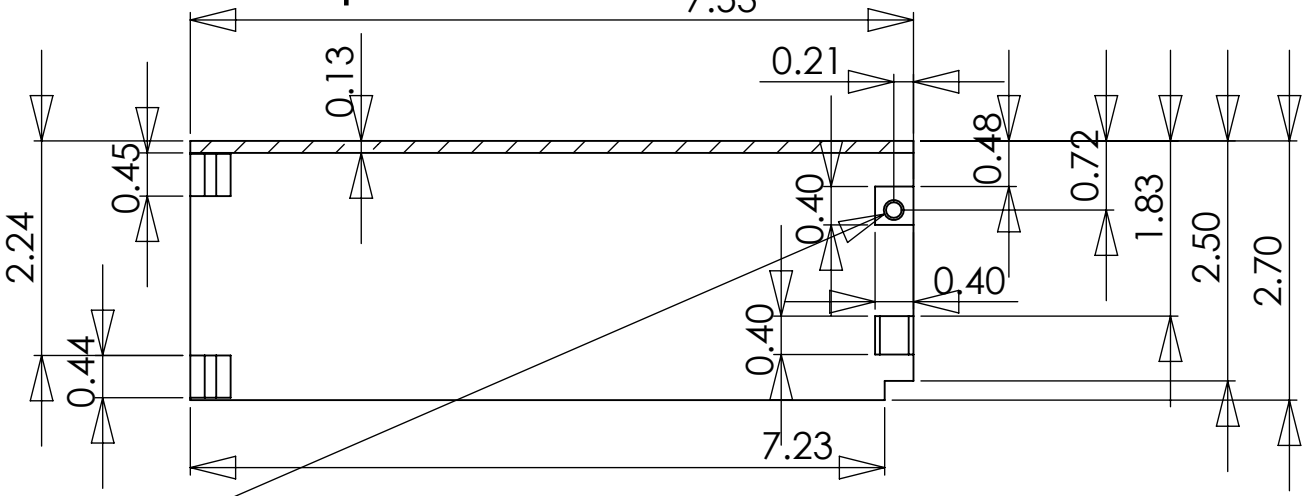


DETAIL F
SCALE 1 : 2





DETAIL G
SCALE 1 : 2



SECTION D-D
SCALE 1 : 2

∅0.21 THRU
<MOD-0.209 X 8°
Insert 6-32 McMaster-Carr
Part #93365A130

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

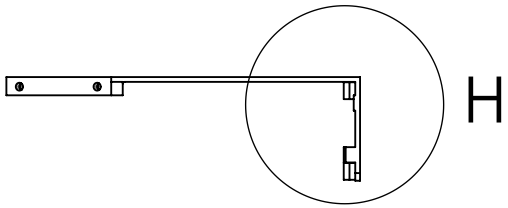
TITLE: Backside housing metal2 (left-1) (page 2 of 3)

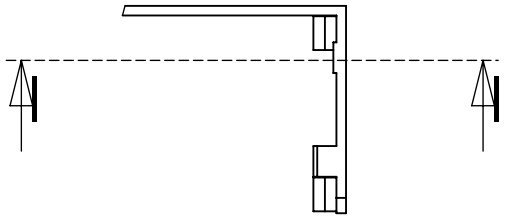
SIZE	DWG. NO.	REV
A		

SCALE: 1:5 WEIGHT: SHEET 2 OF 3

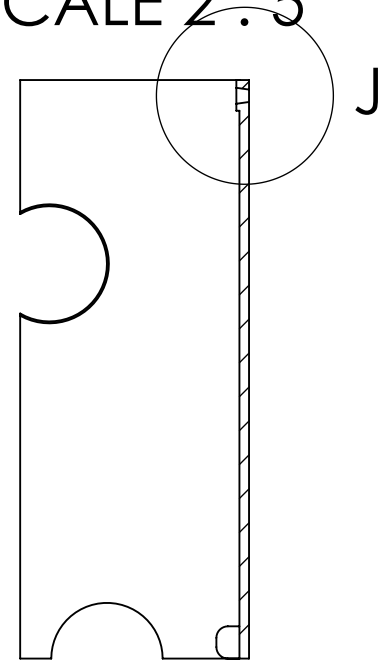
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

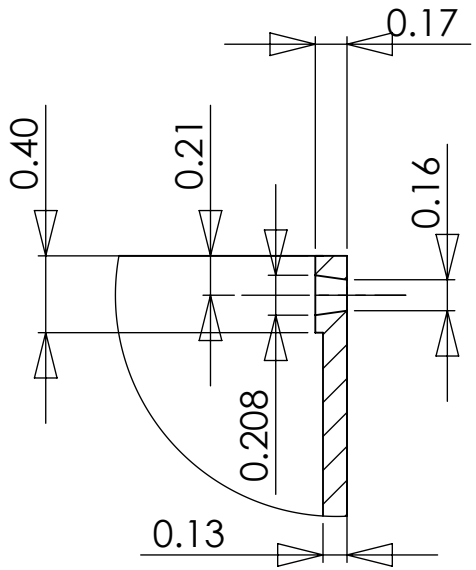




DETAIL H
SCALE 2 : 5



SECTION I-I
SCALE 2 : 5



DETAIL J
SCALE 1 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

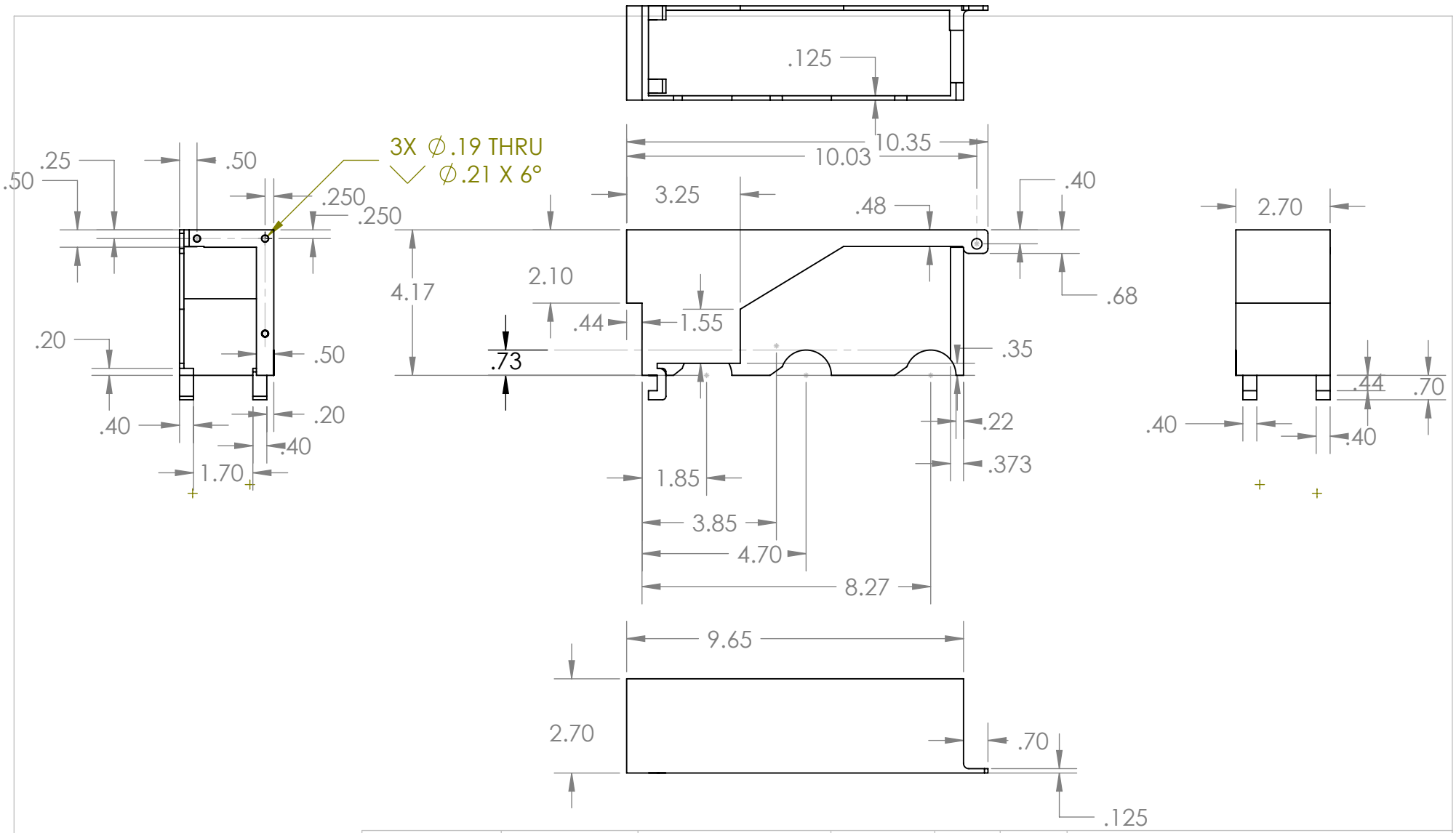
TITLE: Backside housing metal2 (left-1) (page 3 of 3)

SIZE	DWG. NO.	REV
A		

SCALE: 1:5 | WEIGHT: | SHEET 3 OF 3

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

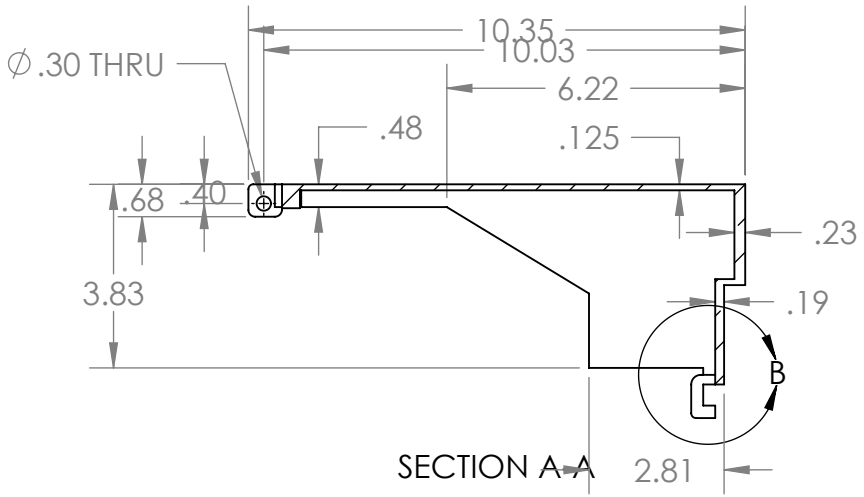
Backside Housing (right) (p. 1 of 3)

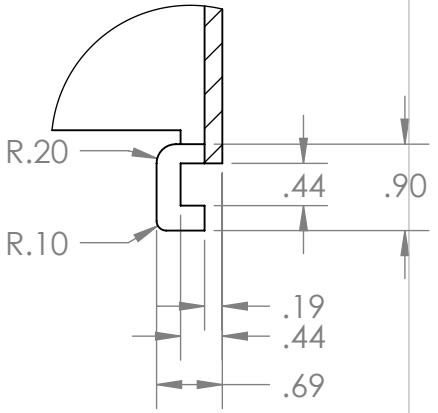
SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 3

5 4 3 2 1

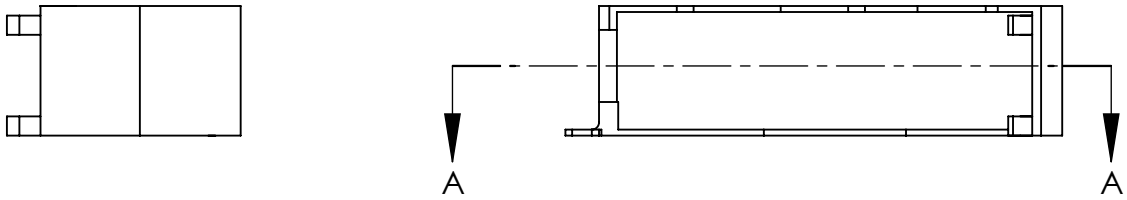
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





DETAIL B
SCALE 1 : 2

Dimensions apply to 2X tabs.



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

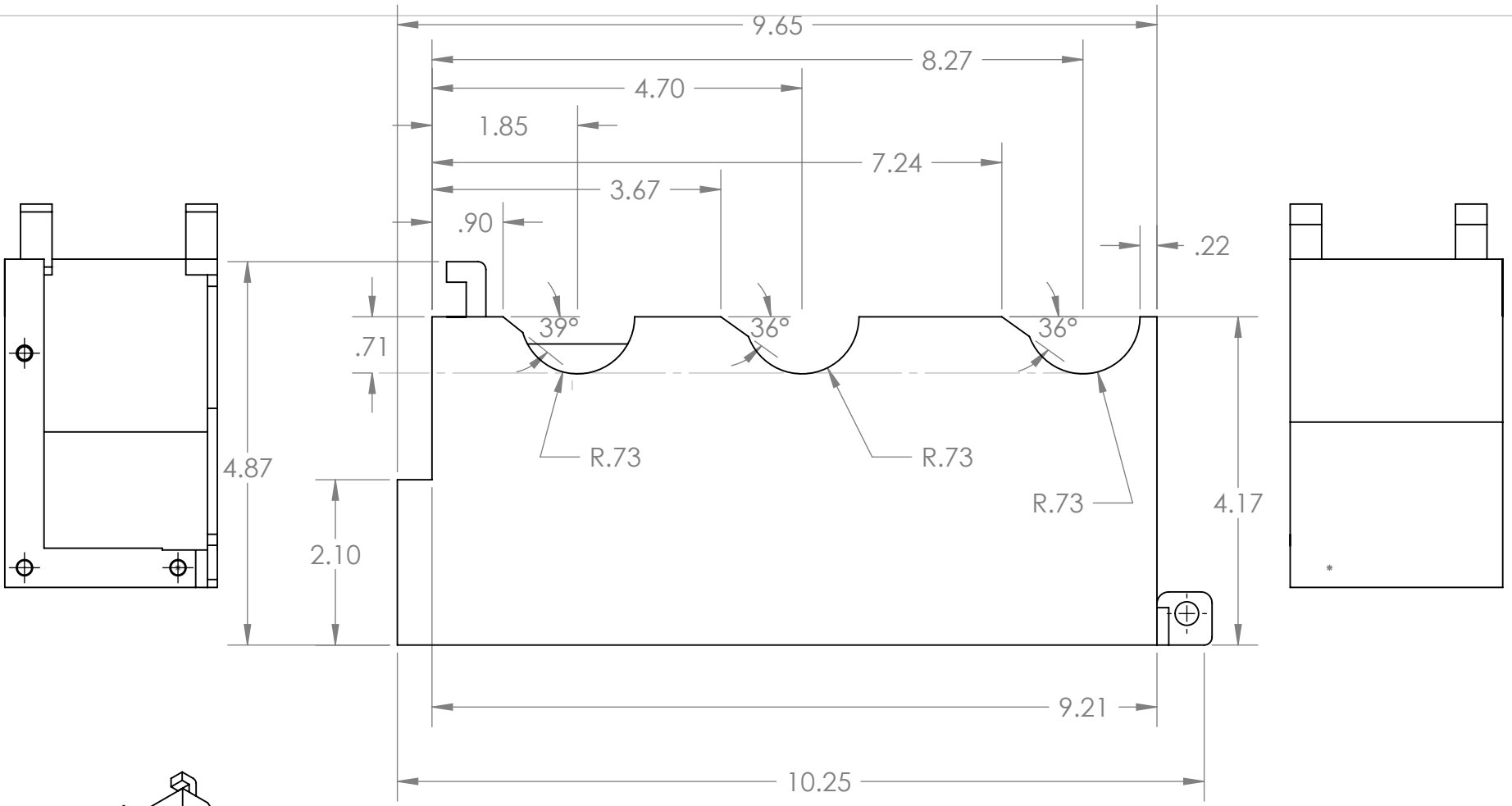
TITLE:
Backside Housing (right)
(p. 2 of 3)

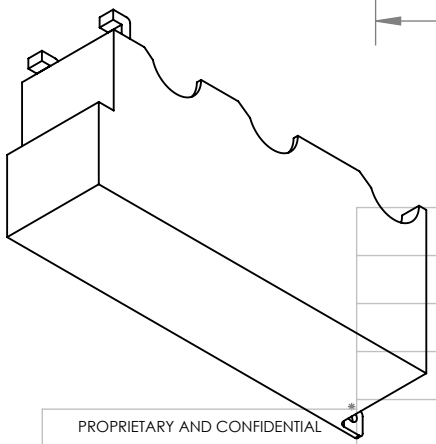
SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 2 OF 3

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





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			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		INTERPRET GEOMETRIC TOLERANCING PER:	COMMENTS:		
		MATERIAL			
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

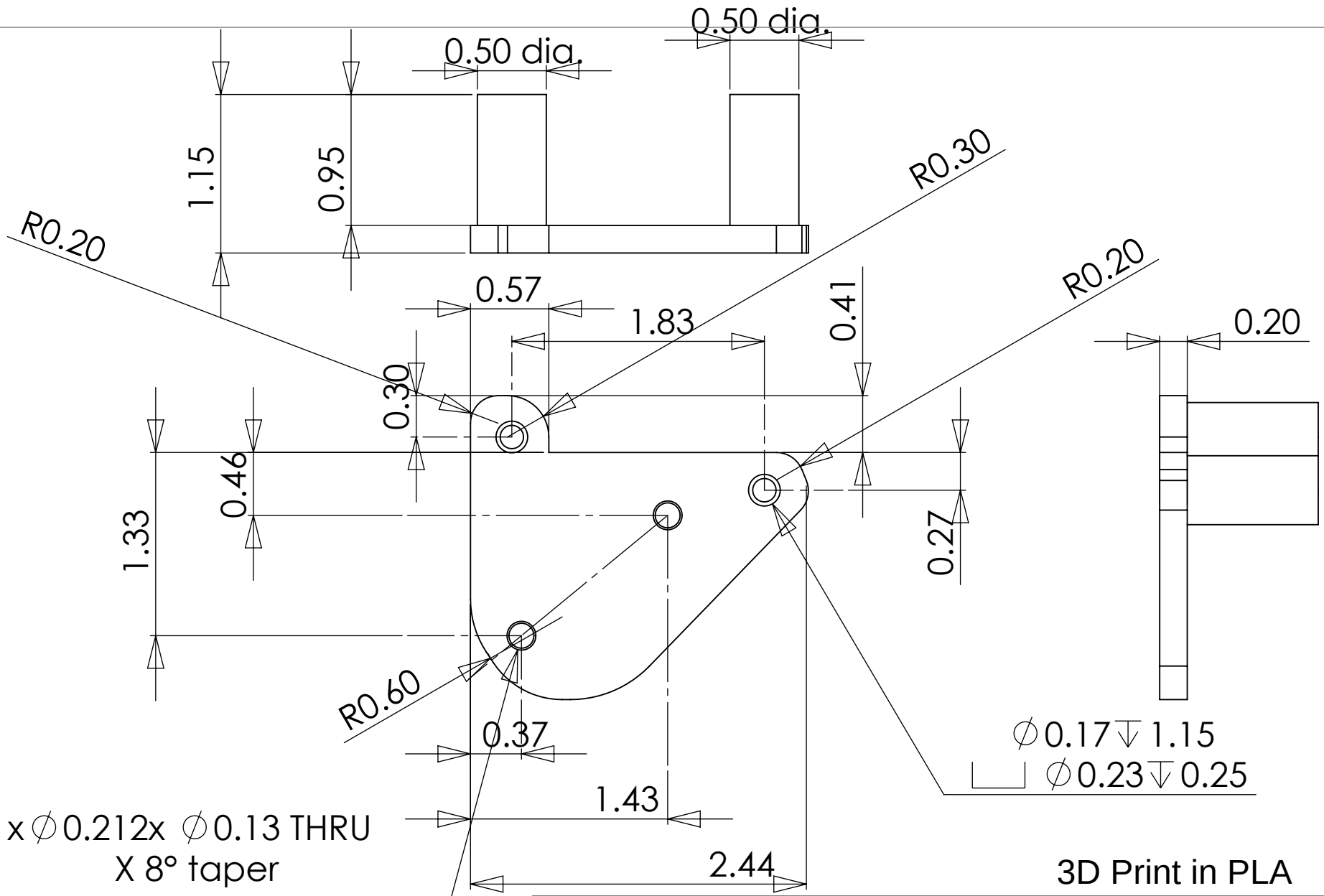
Backside Housing (right) (p. 3 of 3)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 3 OF 3

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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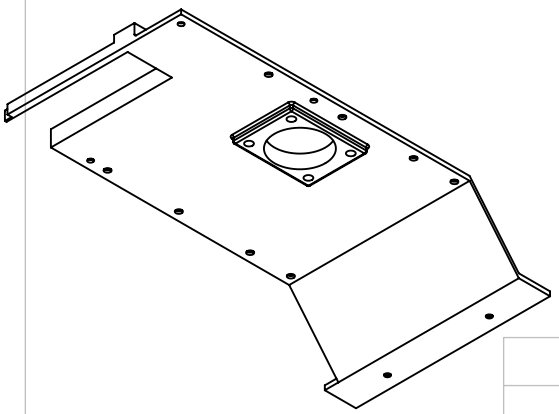
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
NEXT ASSY	USED ON	FINISH --	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

RTD Platform

SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH •			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

TITLE:

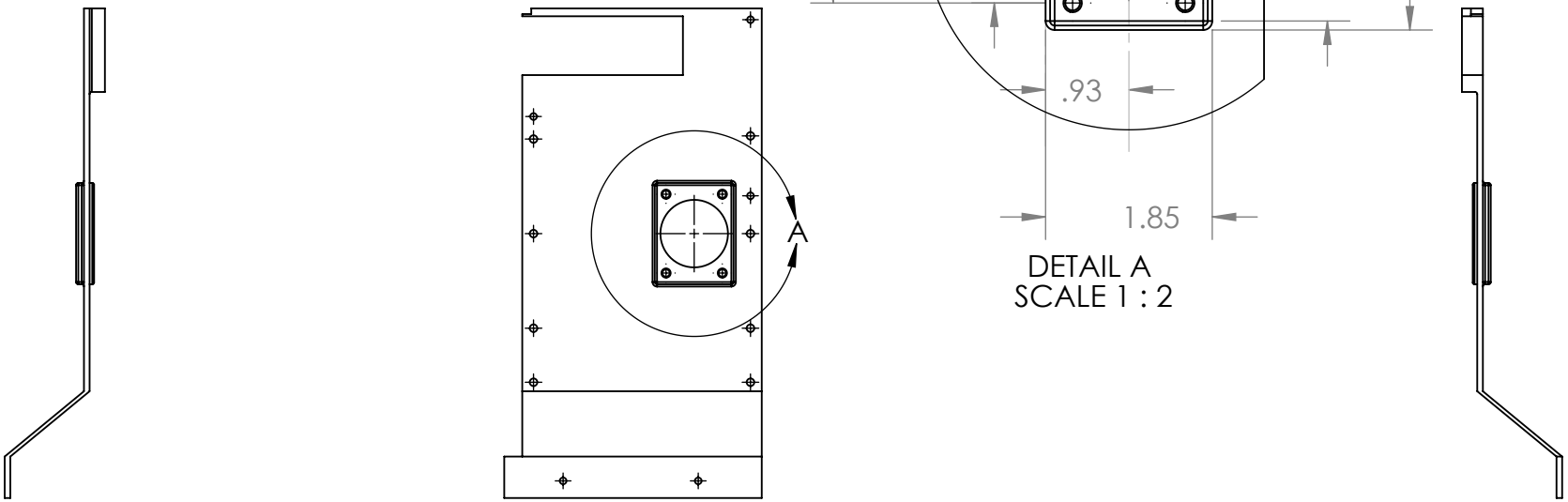
Backside housing top metal (p 1 of 2)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 1 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Backside housing top metal (p 2 of 2)

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH •			
APPLICATION		DO NOT SCALE DRAWING			

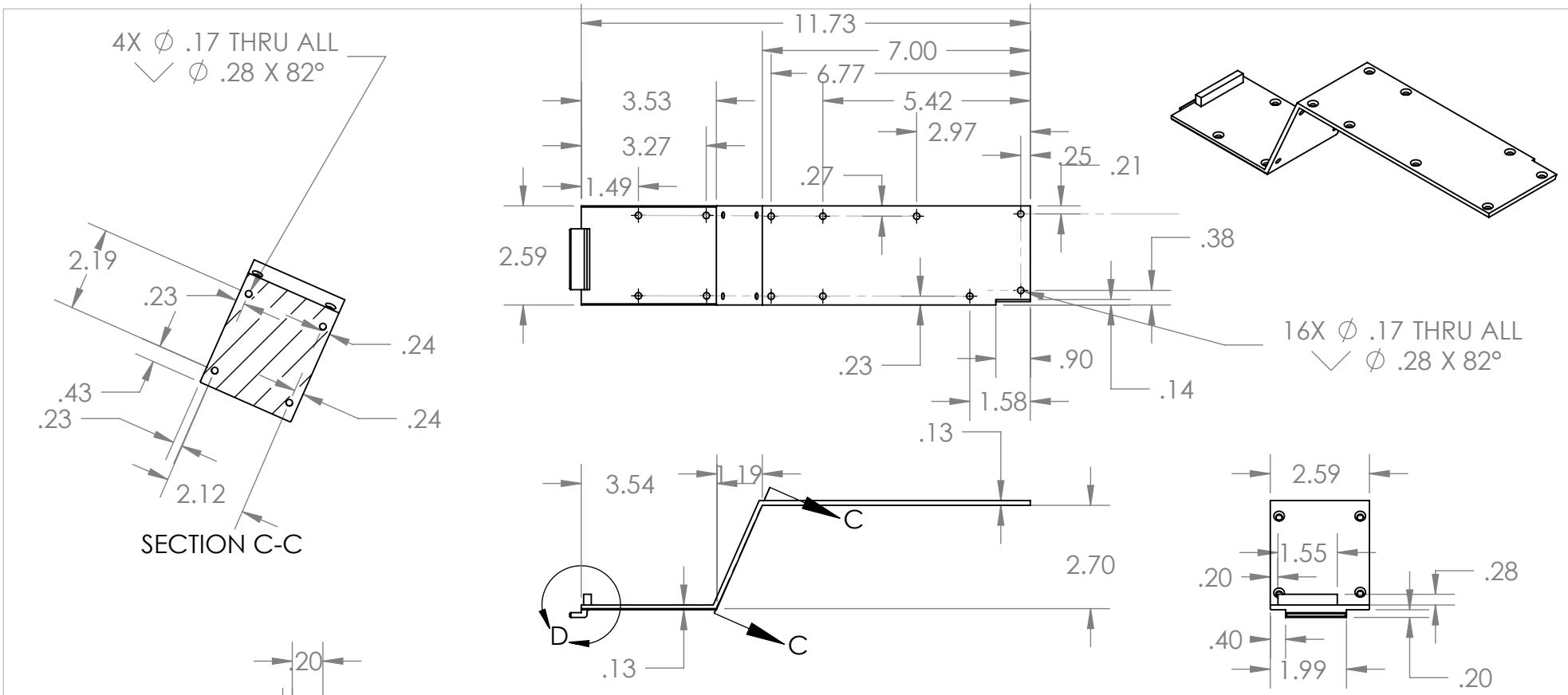
TITLE: Backside housing top metal (p 2 of 2)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 WEIGHT: SHEET 2 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

TITLE:

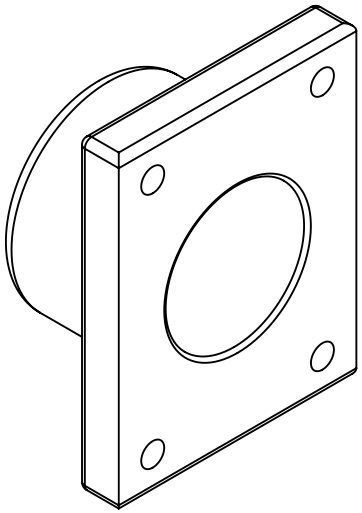
Cover Right Metal

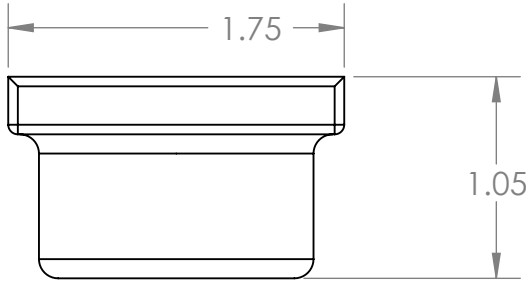
SIZE	DWG. NO.	REV
A		

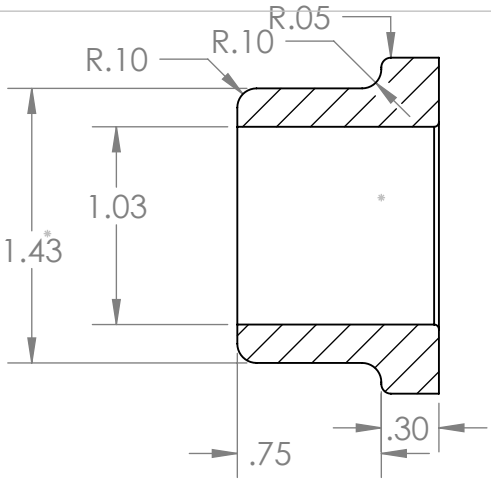
SCALE: 1:4 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

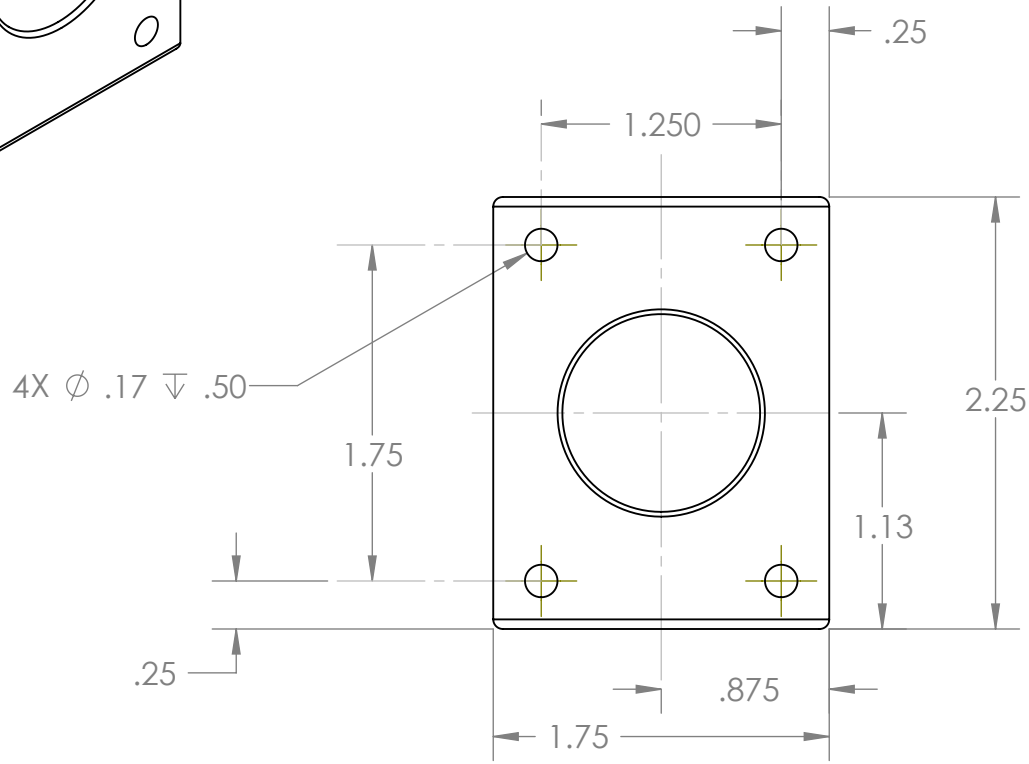
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

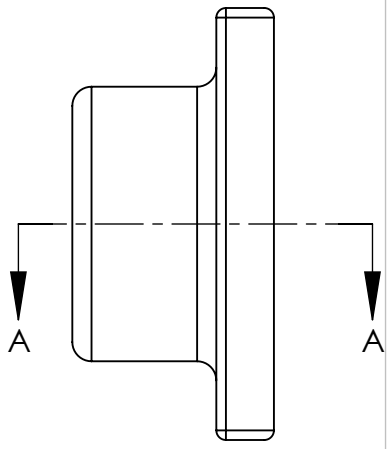






SECTION A-A





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES	DRAWN		
		TOLERANCES:			
		FRACTIONAL<MOD-PM>	CHECKED		
		ANGULAR: MACH<MOD-PM> BEND<MOD-PM>	ENG APPR.		
		TWO PLACE DECIMAL <MOD-PM>			
		THREE PLACE DECIMAL <MOD-PM>	MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
		FINISH			
NEXT ASSY	USED ON				
		APPLICATION	DO NOT SCALE DRAWING		

3D Print in PLA

TITLE:

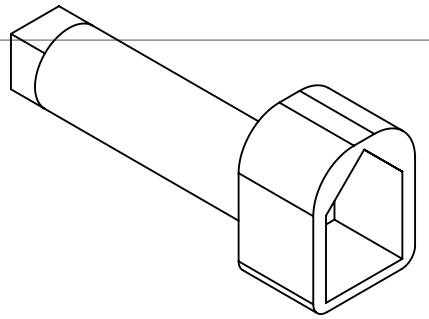
Valve adjust sleeve

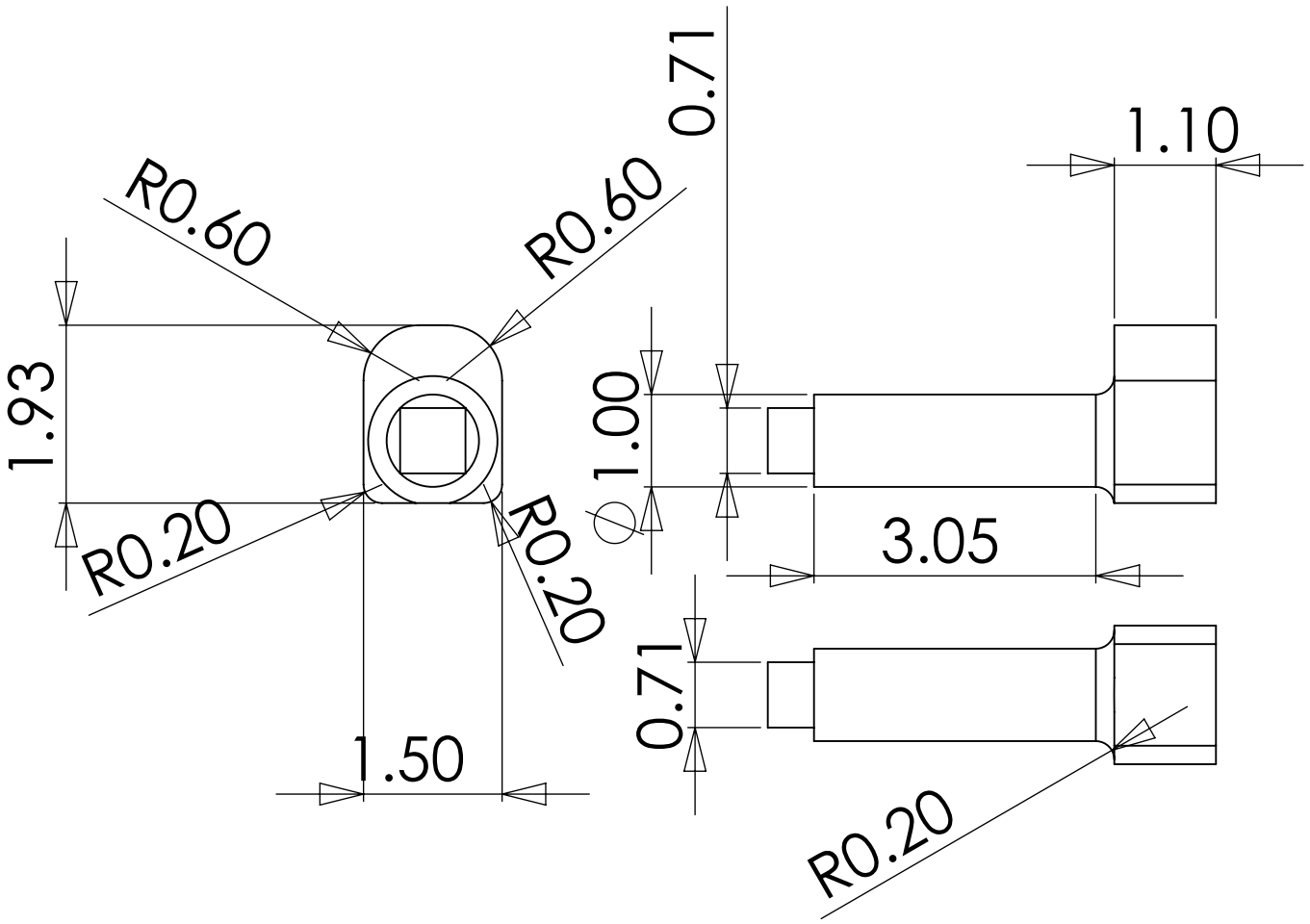
SIZE	DWG. NO.	REV
A		

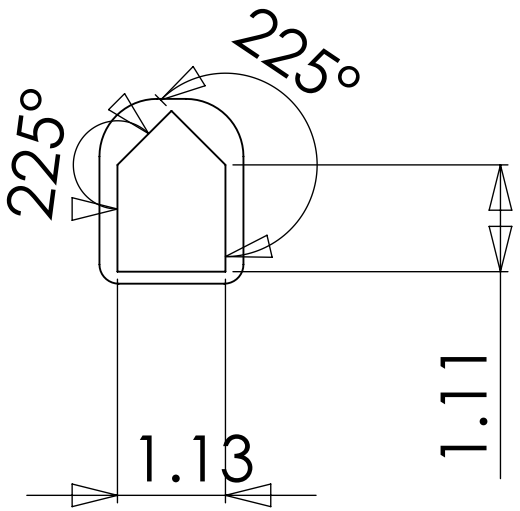
SCALE: 1:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485







3D Print in PLA

w/Standard Resolution,
60% Fill

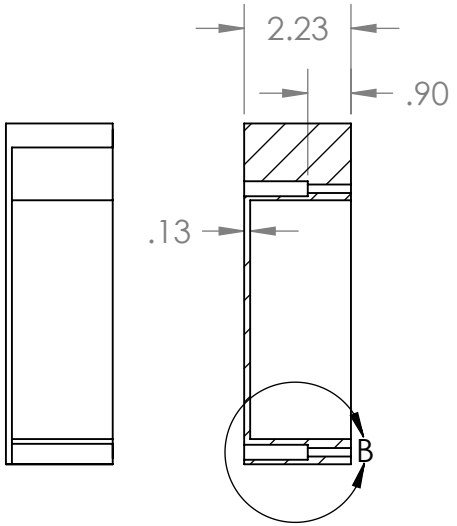
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

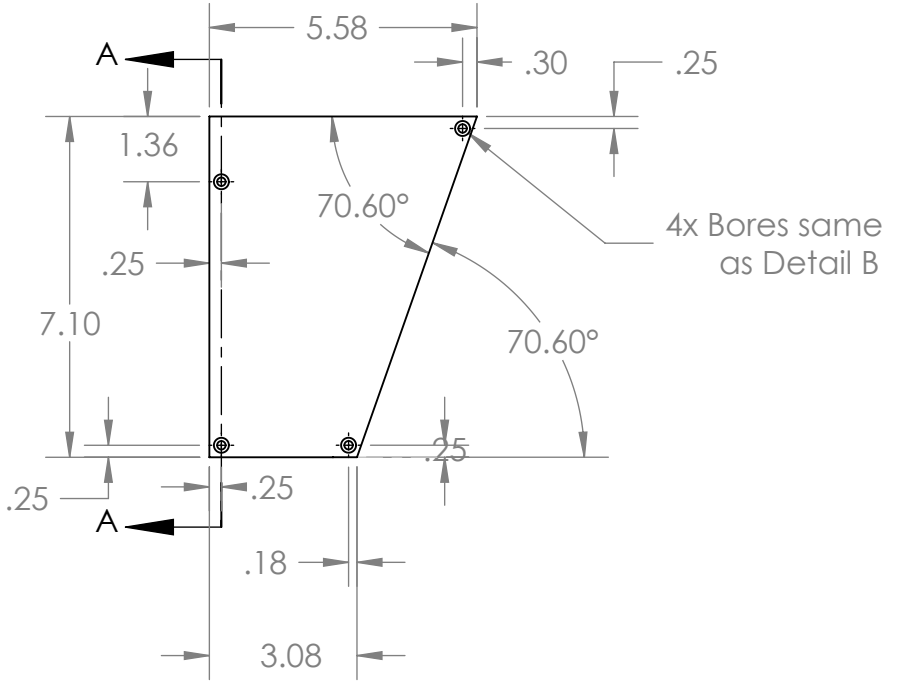
Valve Actuator

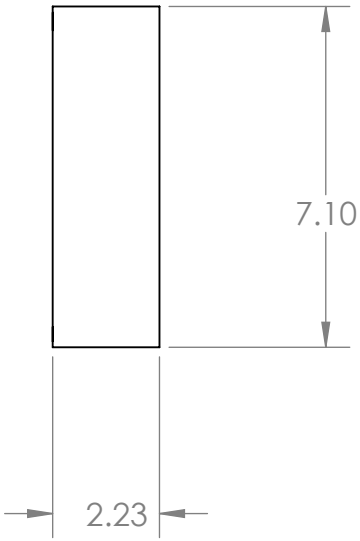
SIZE	DWG. NO.	REV.
A		
SCALE:1:2	WEIGHT:	SHEET 1 OF 1

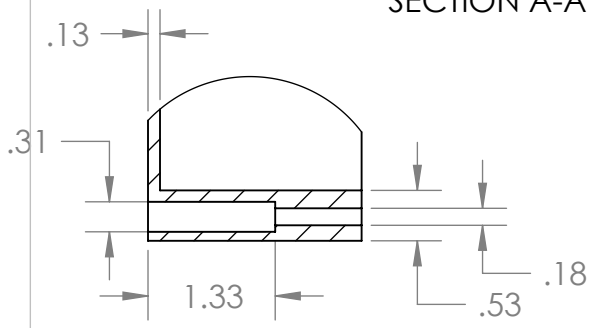
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



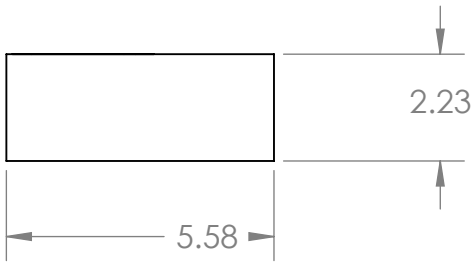
SECTION A-A







DETAIL B
SCALE 1 : 2



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

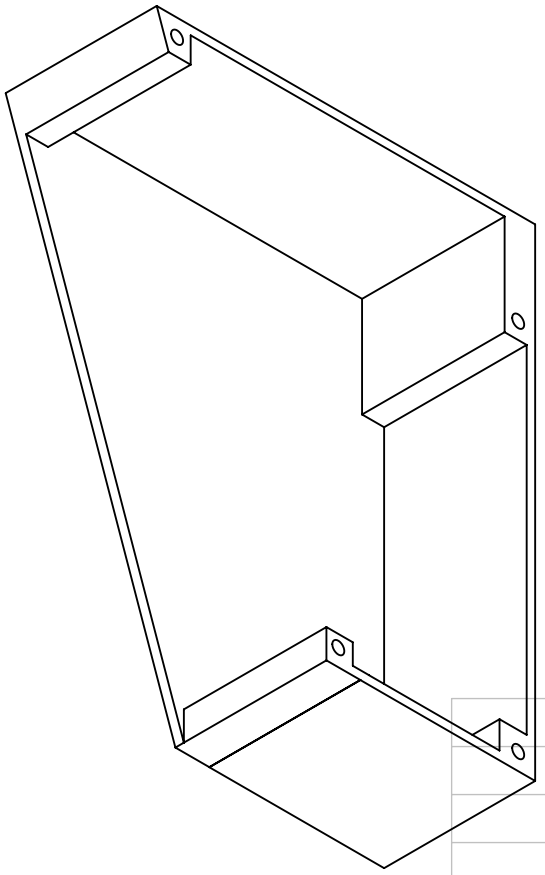
TITLE:
Backside Housing (left-4)
(p. 1 of 2)

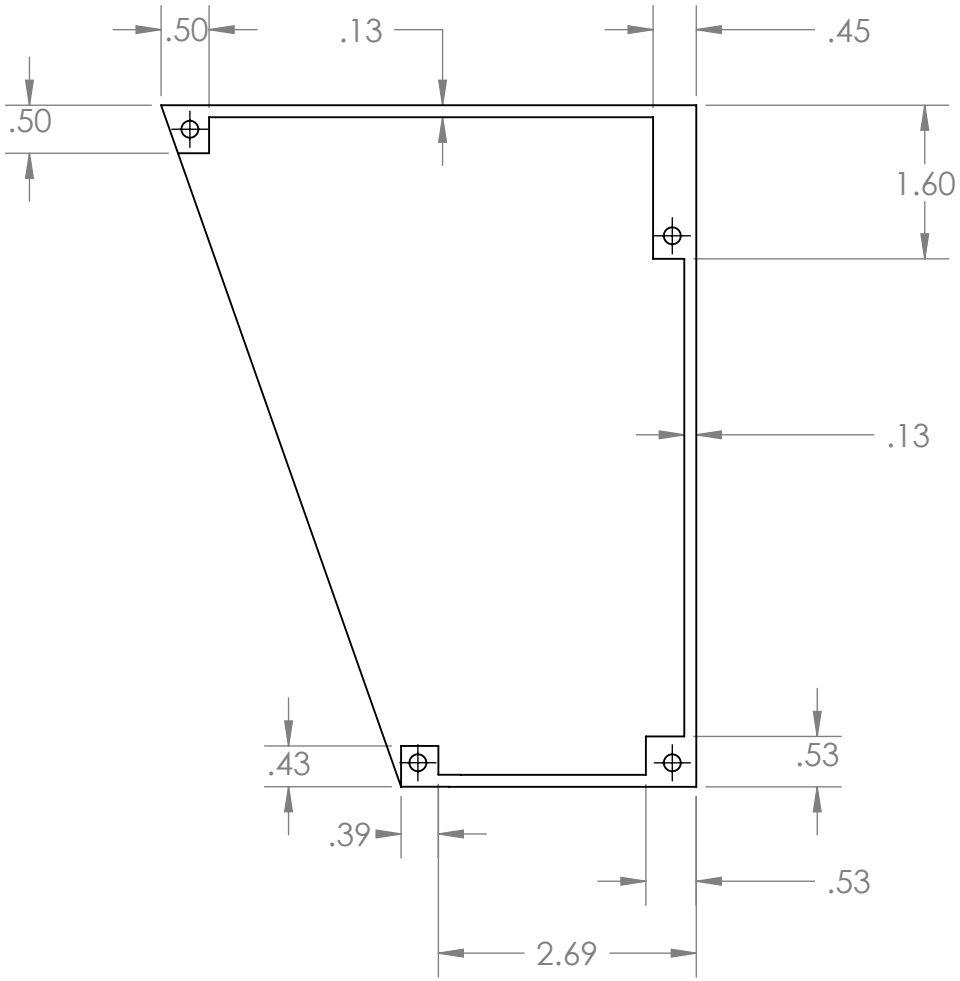
SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

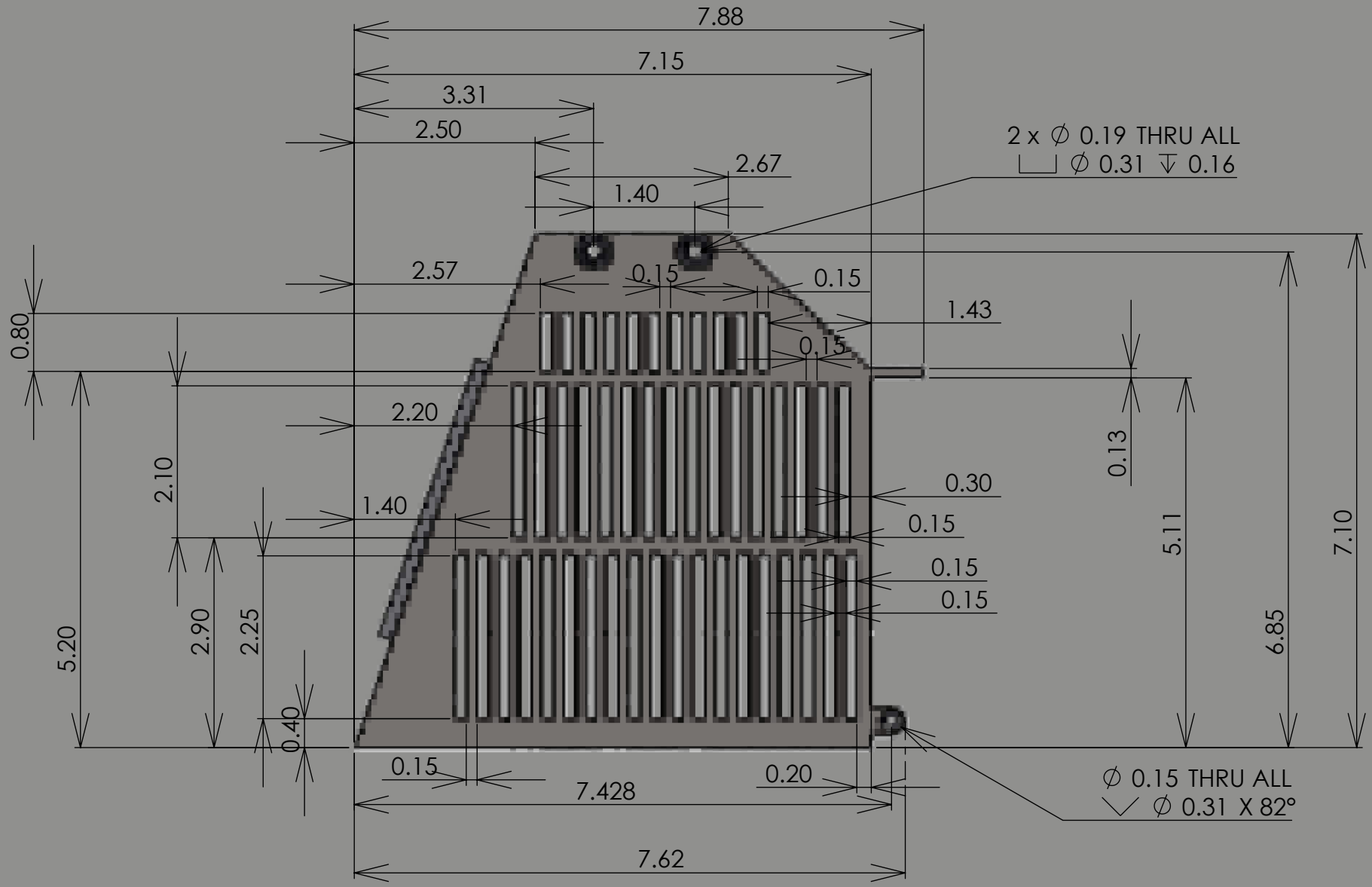
TITLE:
Backside Housing (left-4) (p. 2 of 2)

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL ---

FINISH ---

NEXT ASSY | USED ON

APPLICATION | DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

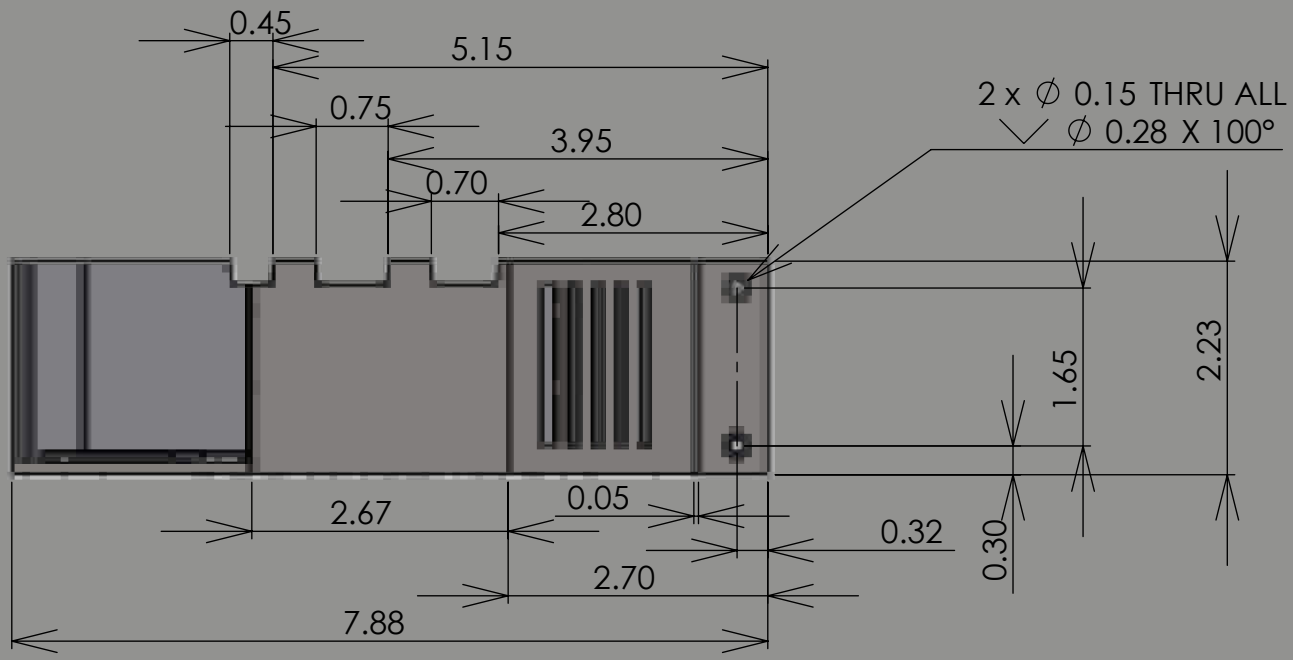
3D Print in PLA

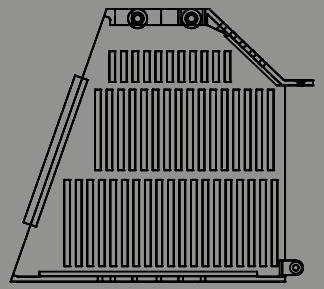
Side Cover (p 1 of 5)

SIZE A | DWG. NO. | REV.

SCALE:1:2 | WEIGHT: | SHEET 1 OF 5

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

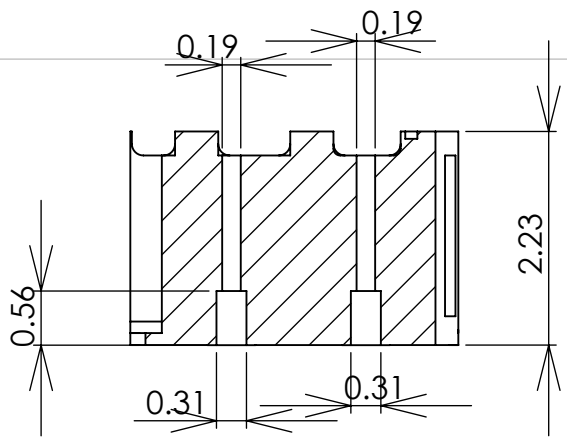
TITLE: Side Cover (p 2 of 5)

SIZE A | DWG. NO. Side Cover | REV

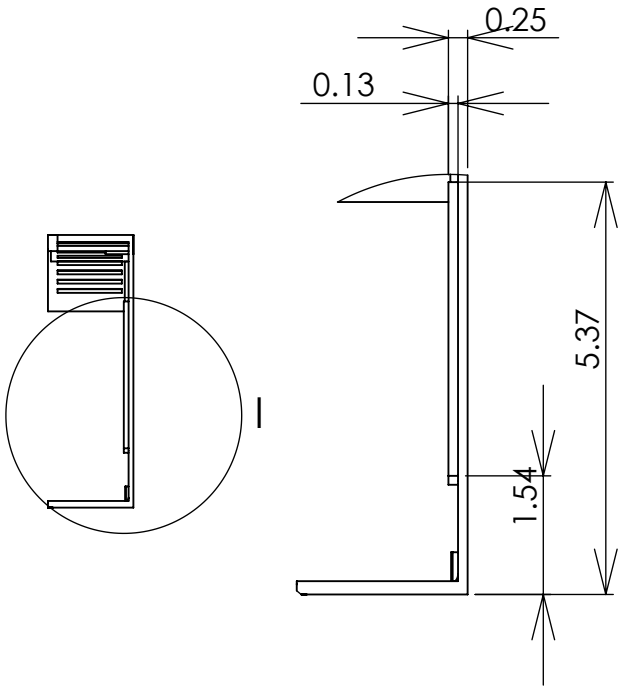
SCALE: 1:2 | WEIGHT: | SHEET 2 OF 5

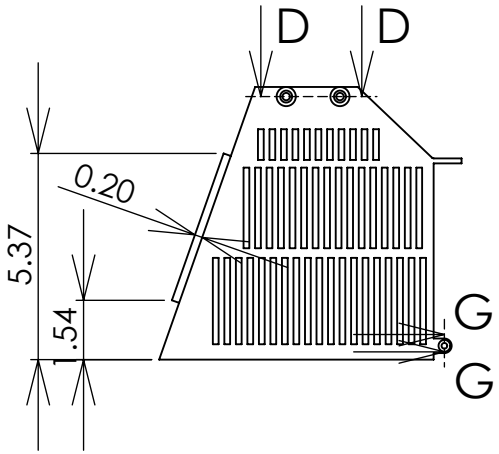
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

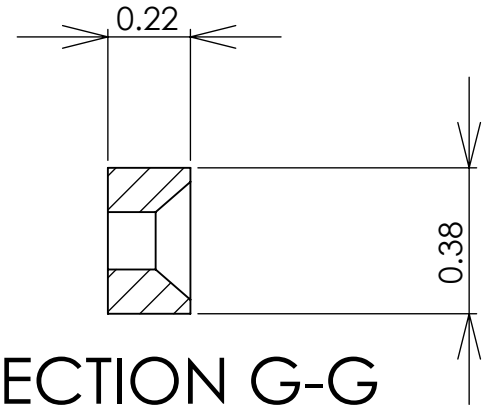


SECTION D-D





Thickness of G-G Tab



SECTION G-G
SCALE 2 : 1

DETAIL I
SCALE 2 : 5

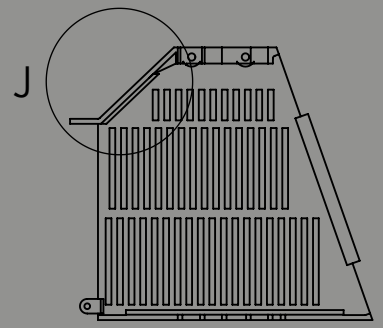
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

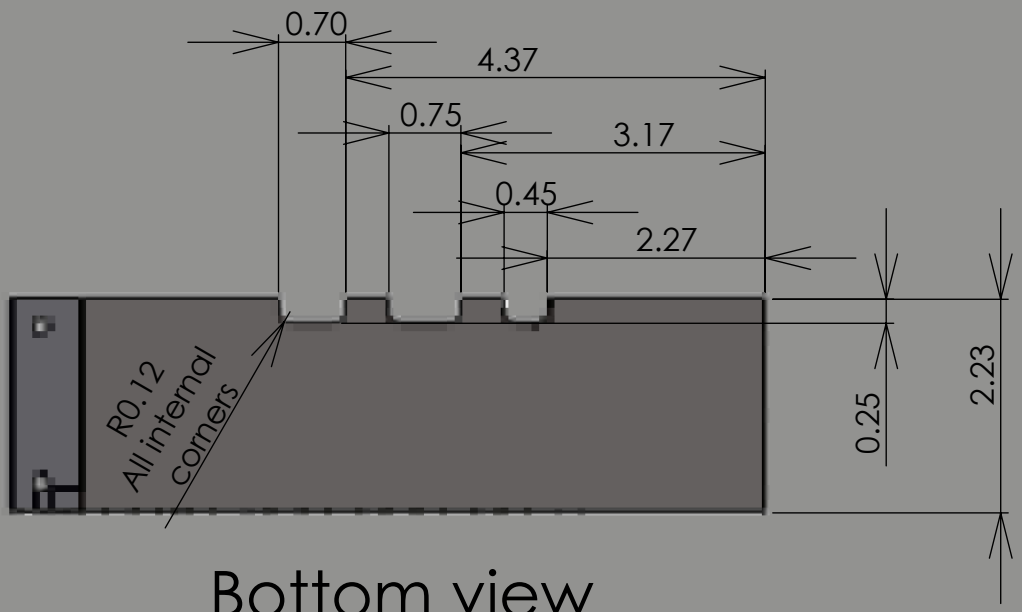
TITLE: Side Cover (p 3 of 5)

SIZE	DWG. NO.	REV
A	Side Cover	
SCALE: 1:2	WEIGHT:	SHEET 3 OF 5

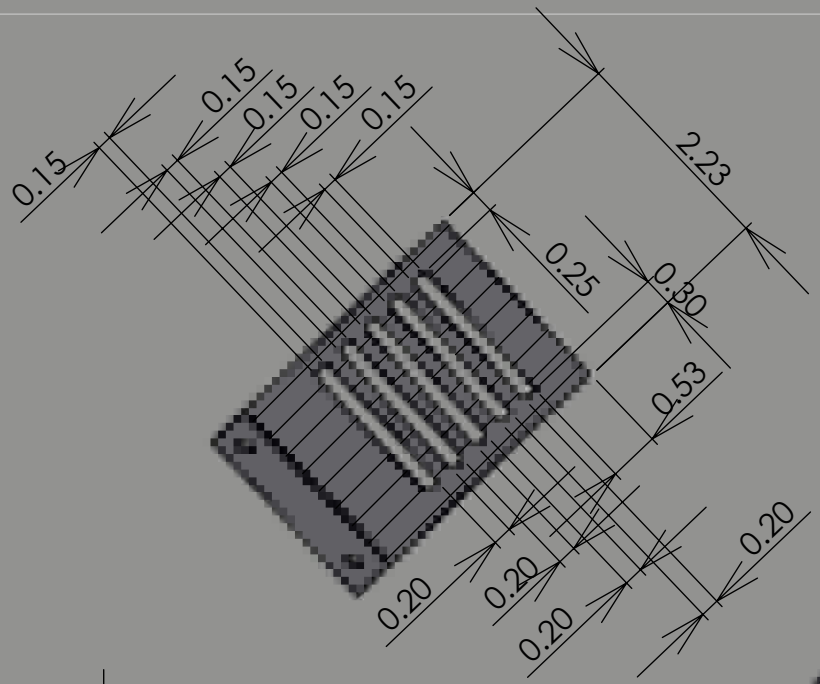
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

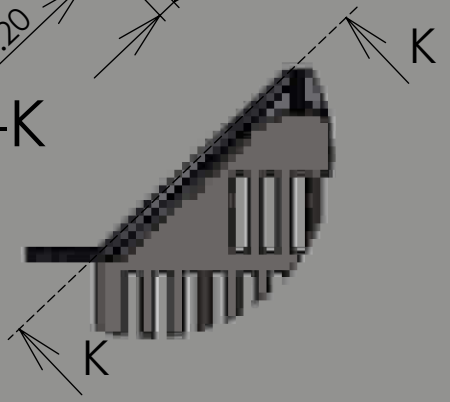




Bottom view



SECTION K-K



DETAIL J

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

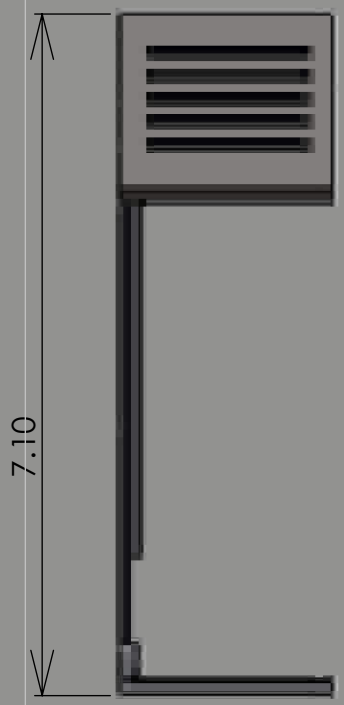
TITLE: Side Cover (p 4 of 5)

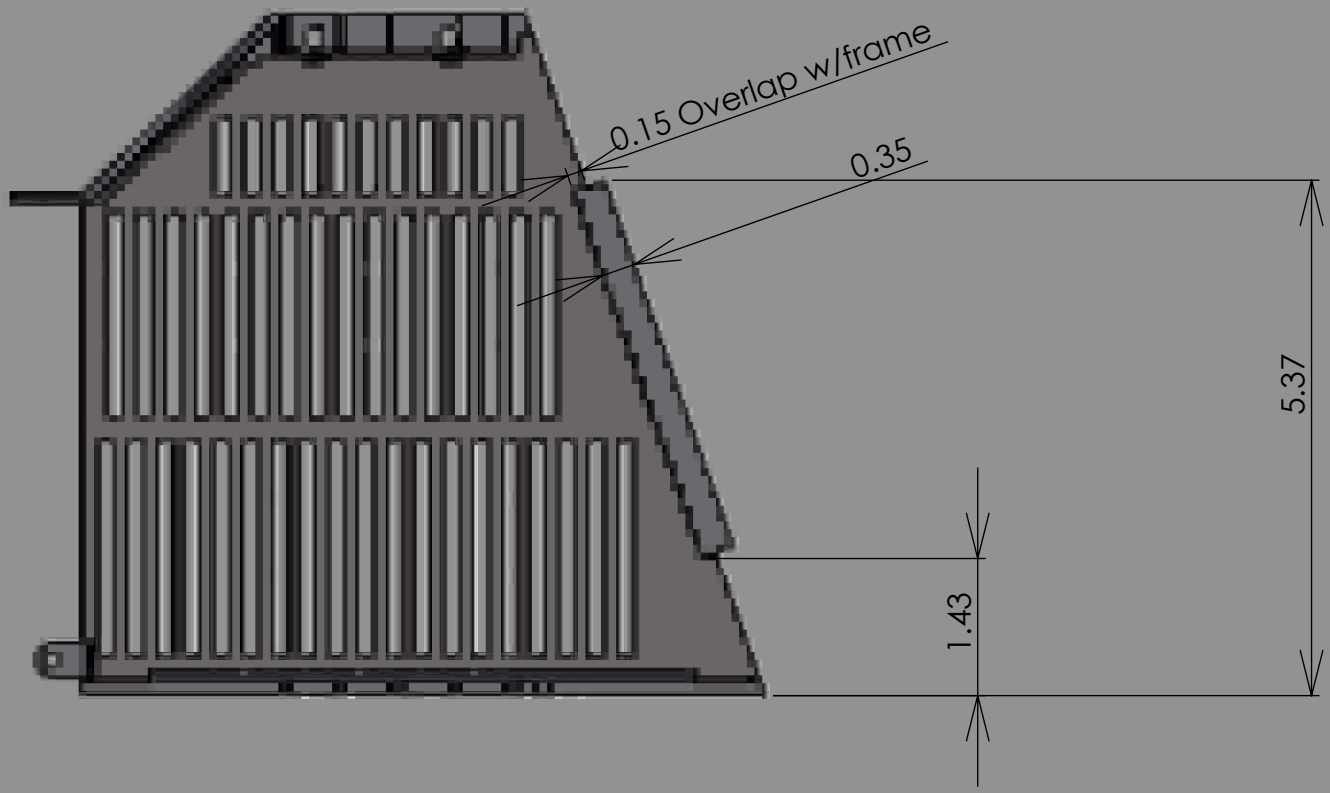
SIZE	DWG. NO.	REV
A	Side Cover	

SCALE: 1:2 WEIGHT: SHEET 4 OF 5

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:

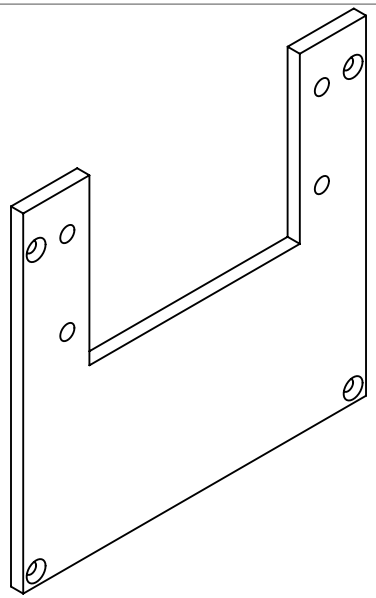
Side Cover (p 5 of 5)

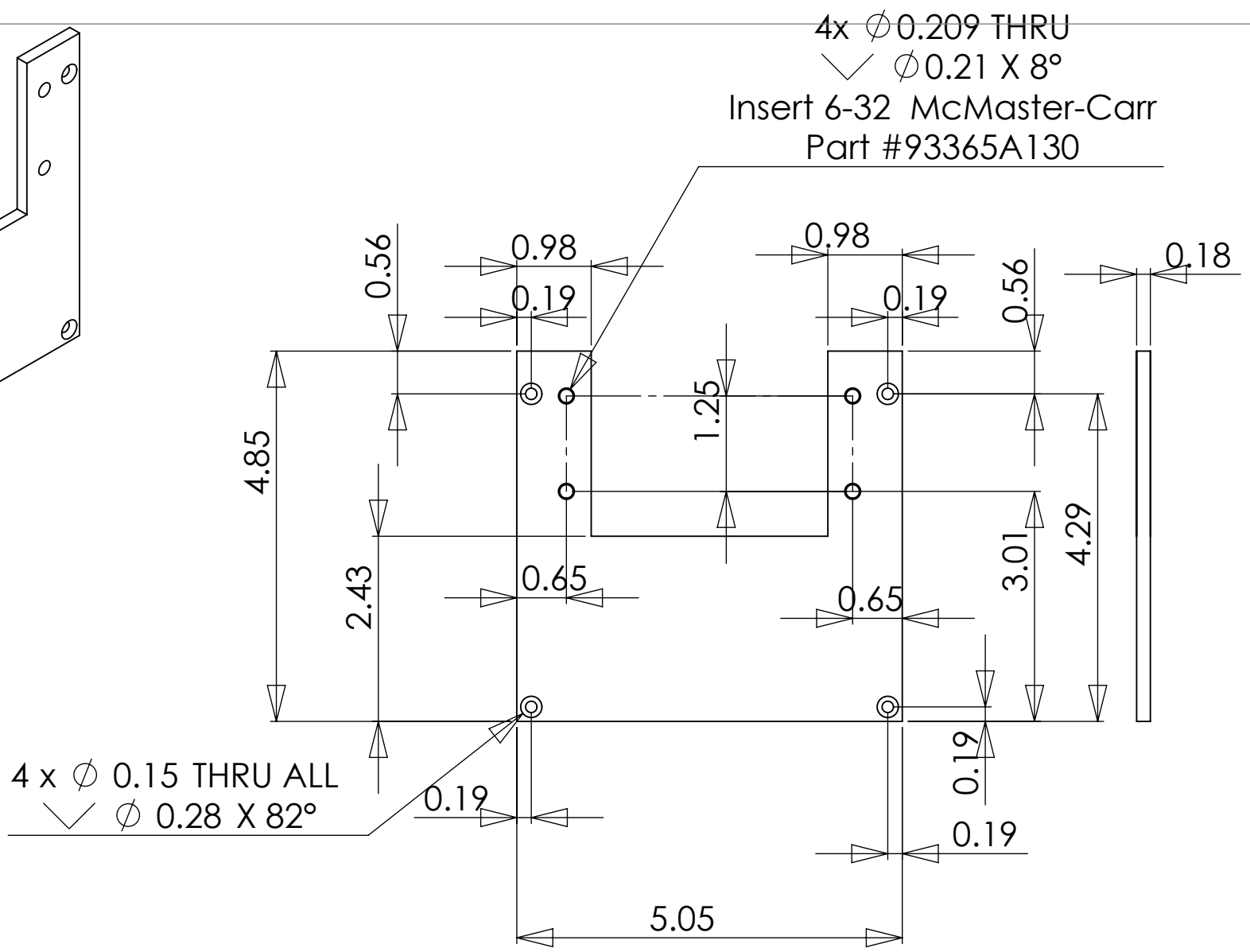
SIZE	DWG. NO.	REV
A	Side Cover	

SCALE: 1:2 WEIGHT: SHEET 5 OF 5

5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485





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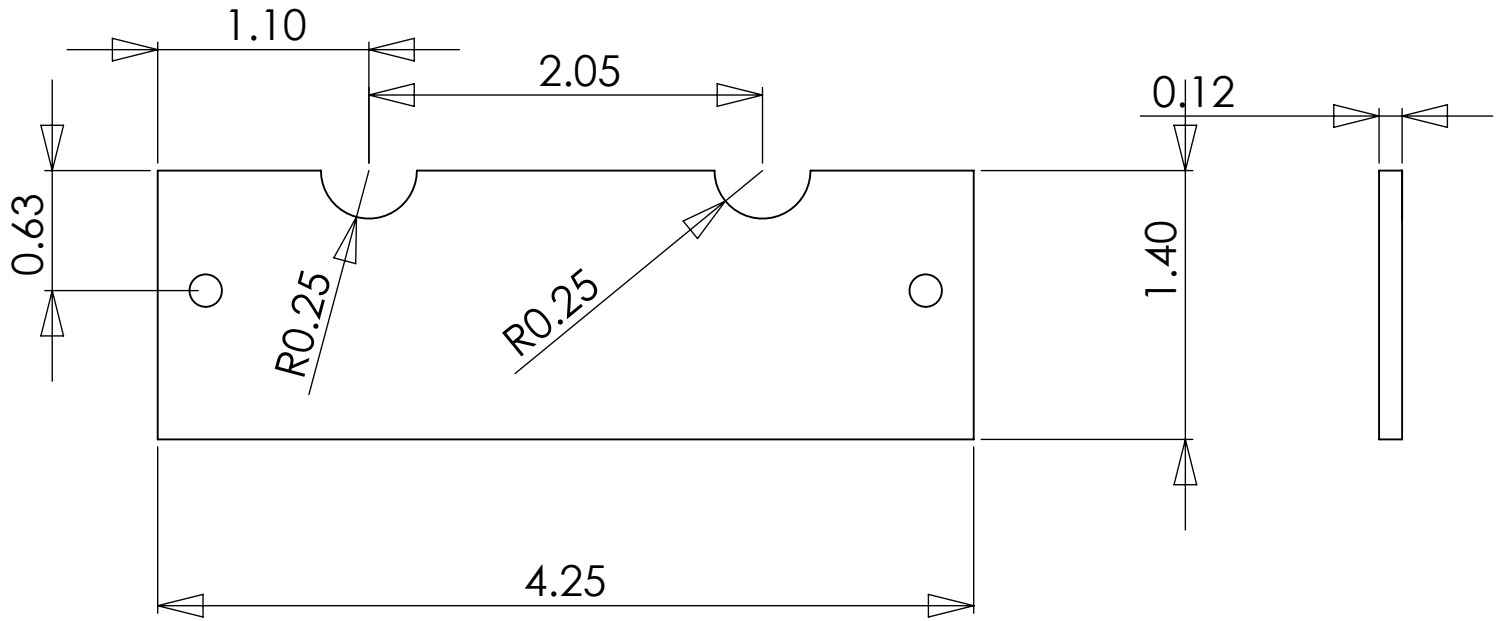
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

3D Print in PLA

Cryo-Bulkhead

SIZE	DWG. NO.	REV.
A		
SCALE:1:2	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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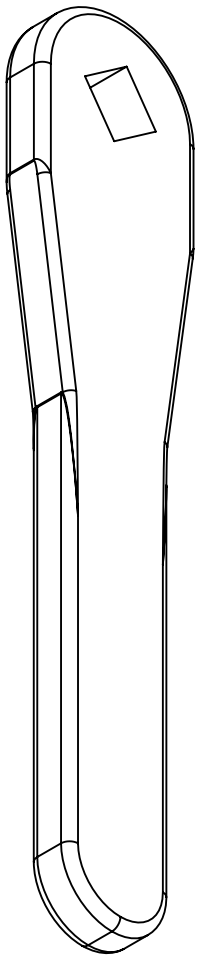
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

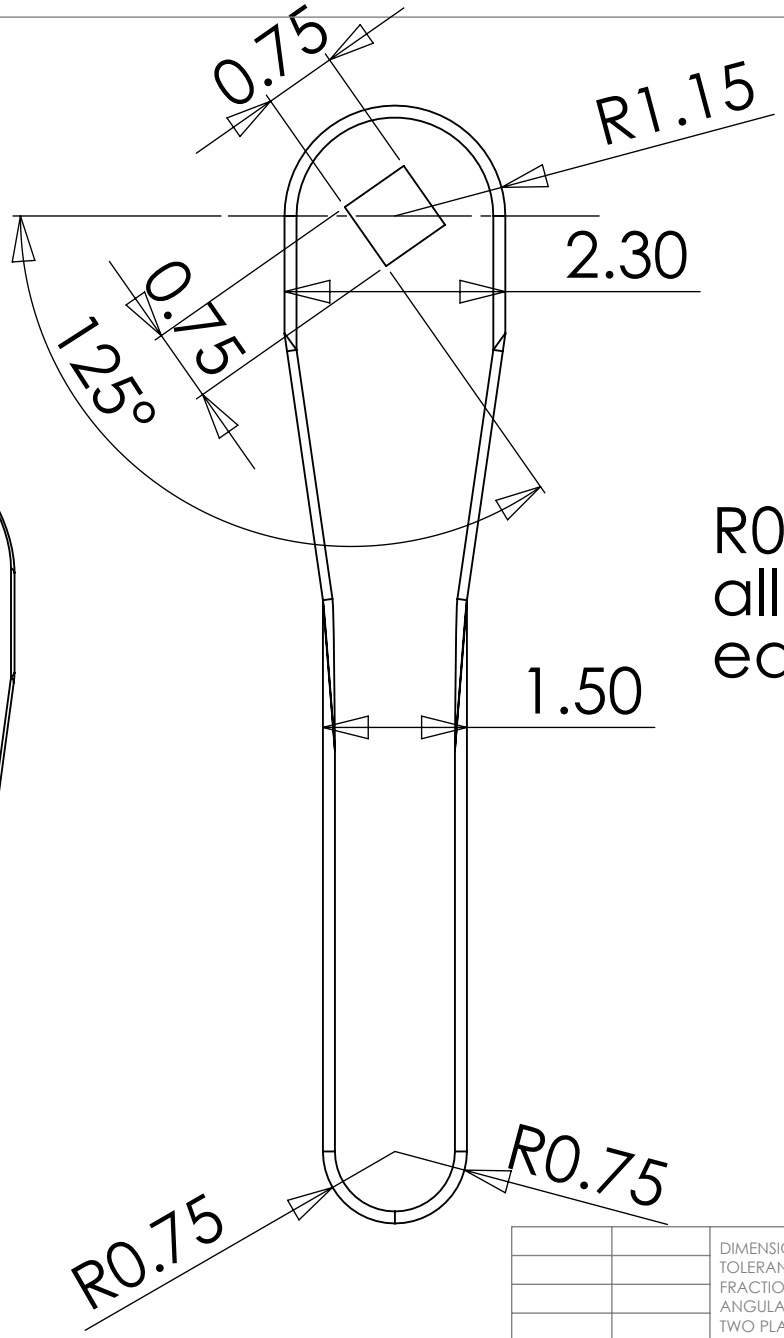
3D Print in PLA

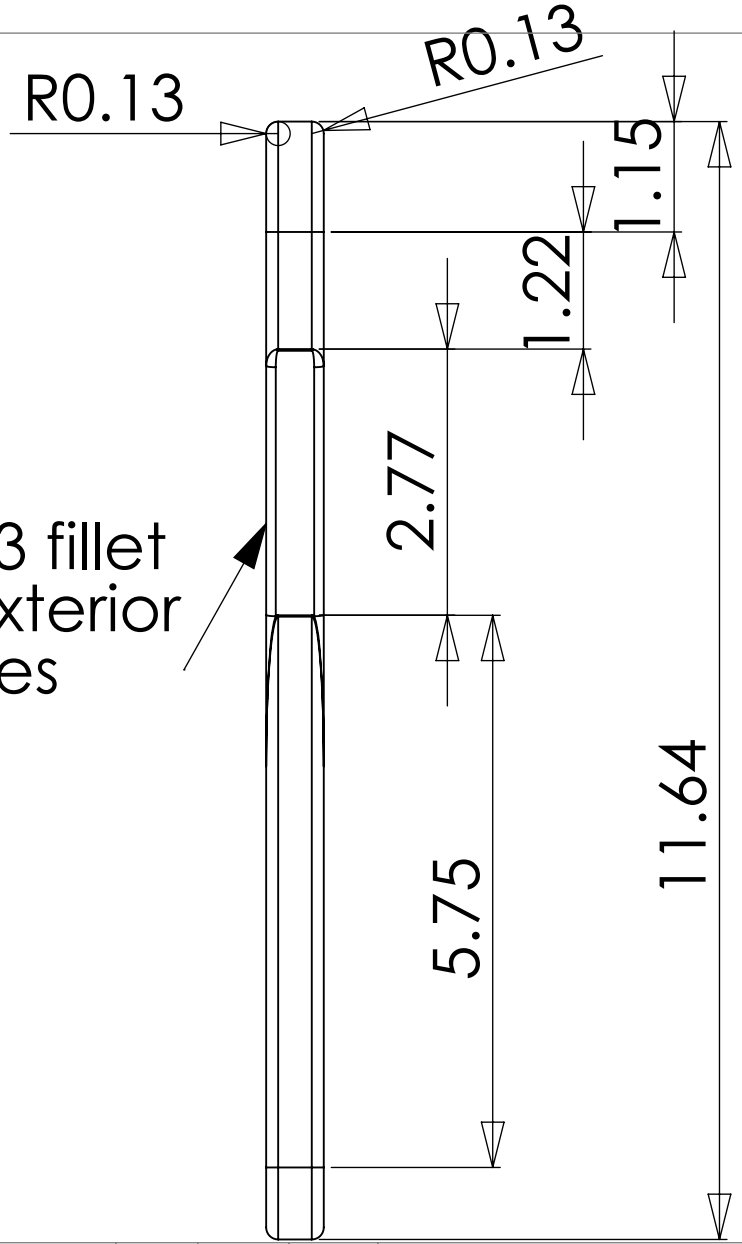
Coolant Exit Plate

SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485







R0.13 fillet all exterior edges

		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

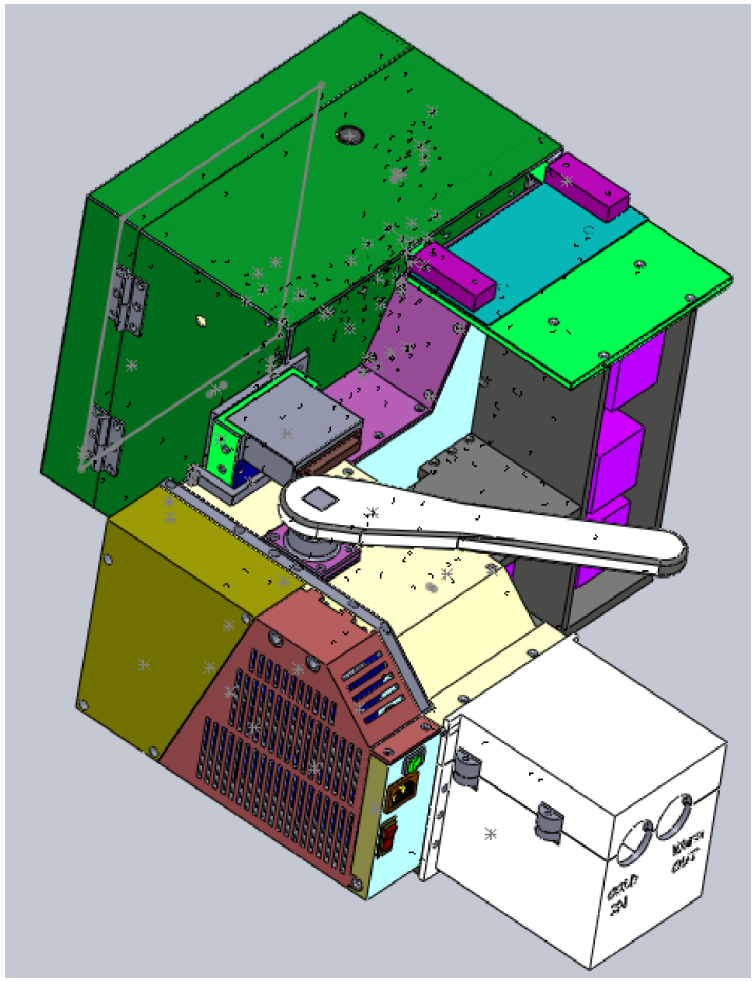
3D Print in PLA (60% Fill)

Valve Wrench

SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 1 OF 1

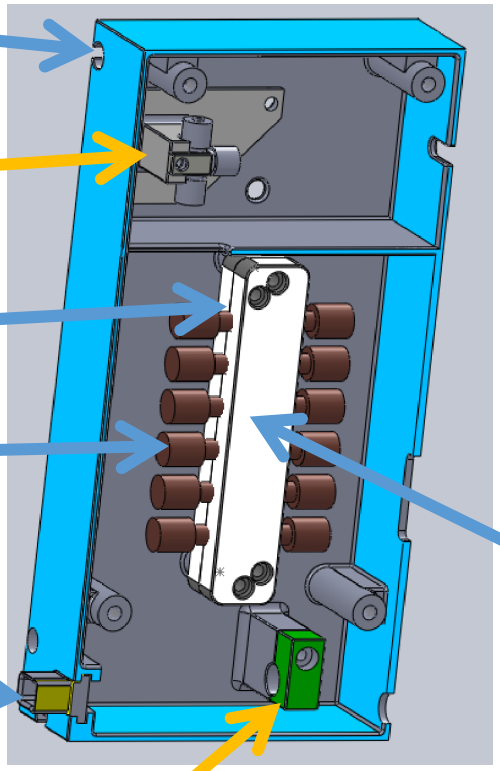
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Showing Assembly of Backside Housing and HPLC



Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485

Accessory Box showing Solvent Entry Rack



Accessory box (part 1)
[FILE: Accessory box (part 1).STL]

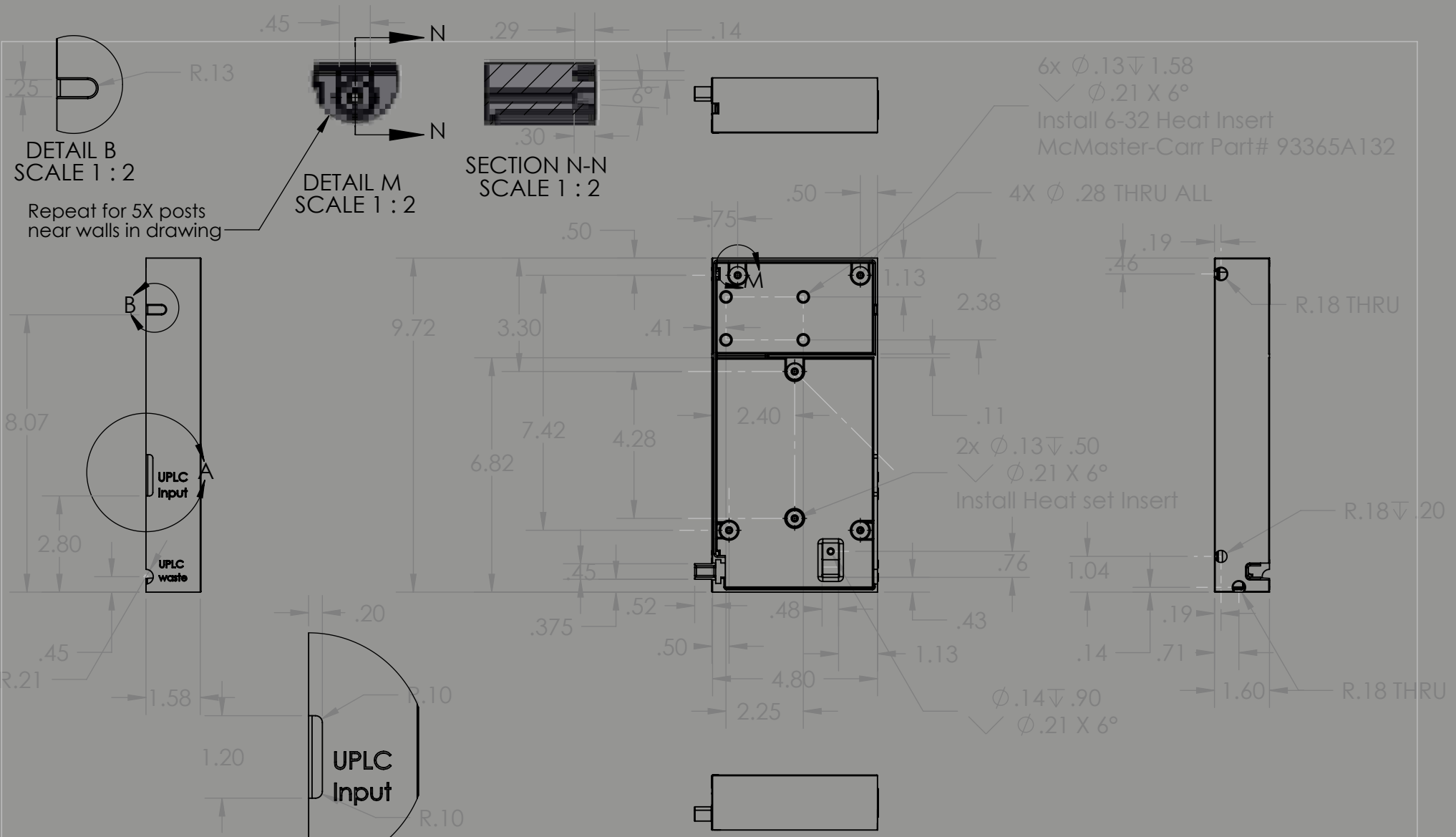
Union Holder (Optimize Tech) (Bottom)
[FILE: union holder optimize (bottom).STL]

Snout Removable
[File: Accessory box (part 1b)]

.
.
[
]

Waste Hose Clamp
[FILE: Acc Hose Clamp.STL]

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

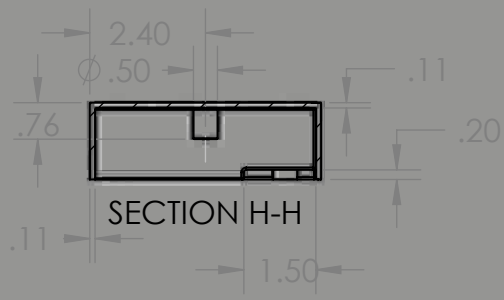
3D Print in PLA (60% fill)

TITLE:
Accessory Box (part 1)
page 1 of 2

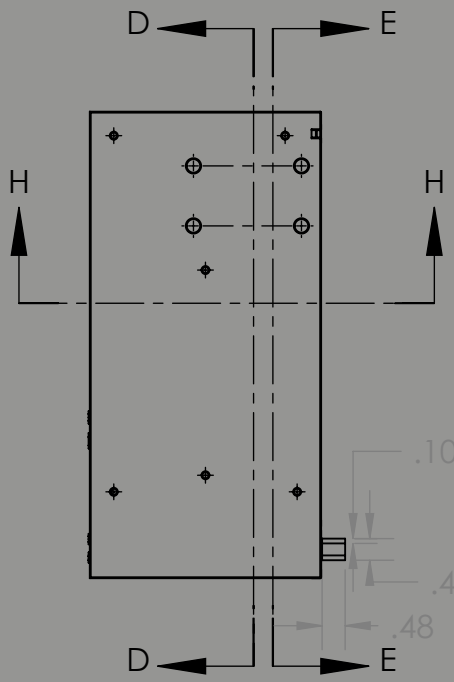
SIZE	DWG. NO.	REV
A		

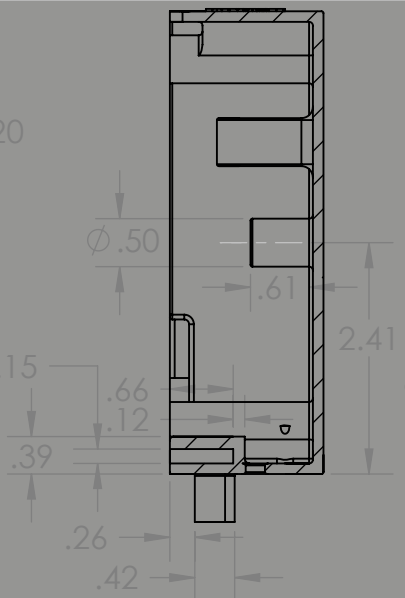
SCALE: 1:4 WEIGHT: SHEET 1 OF 2

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



SECTION H-H





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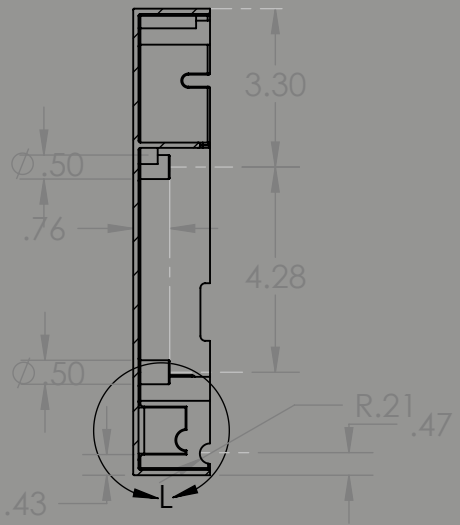
SCALE 1 : 2



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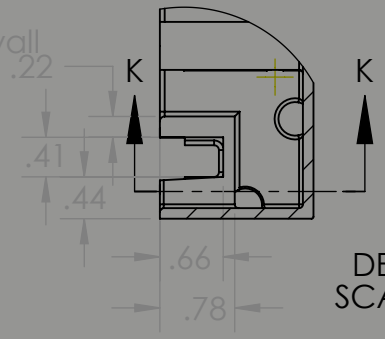
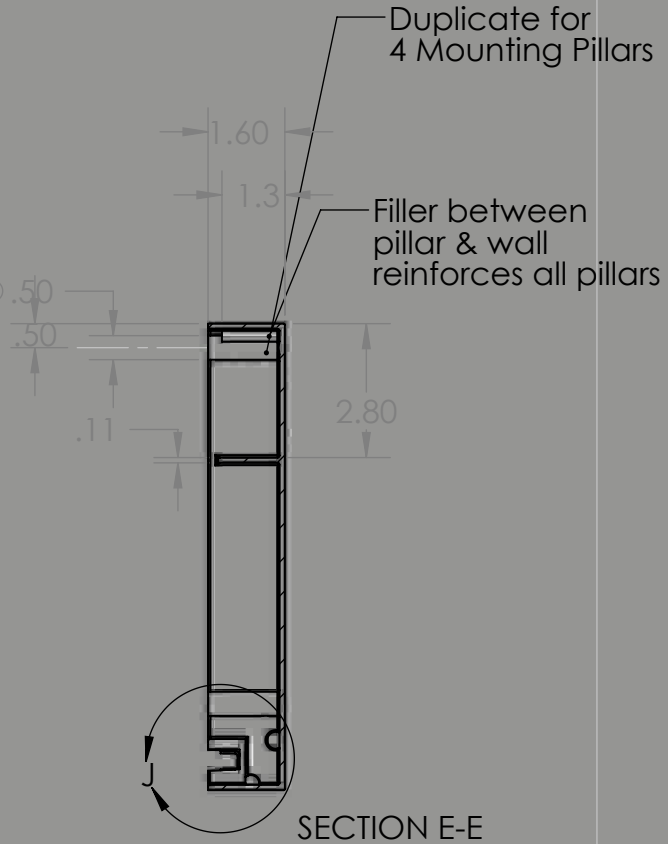


DETAIL J
SCALE 1 : 2



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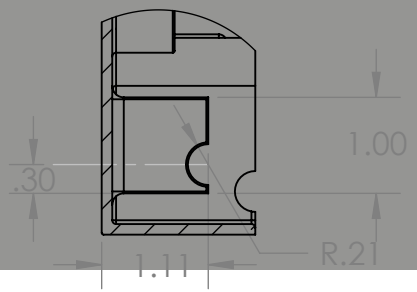

DETAIL L
SCALE 1 : 2

NEXT ASSY | USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

TITLE:

Accessory Box (part 1)
page 2 of 2

SIZE	DWG. NO.	REV
A		

SCALE: 1:4 | WEIGHT: | SHEET 2 OF 2

5 4 3 2 1

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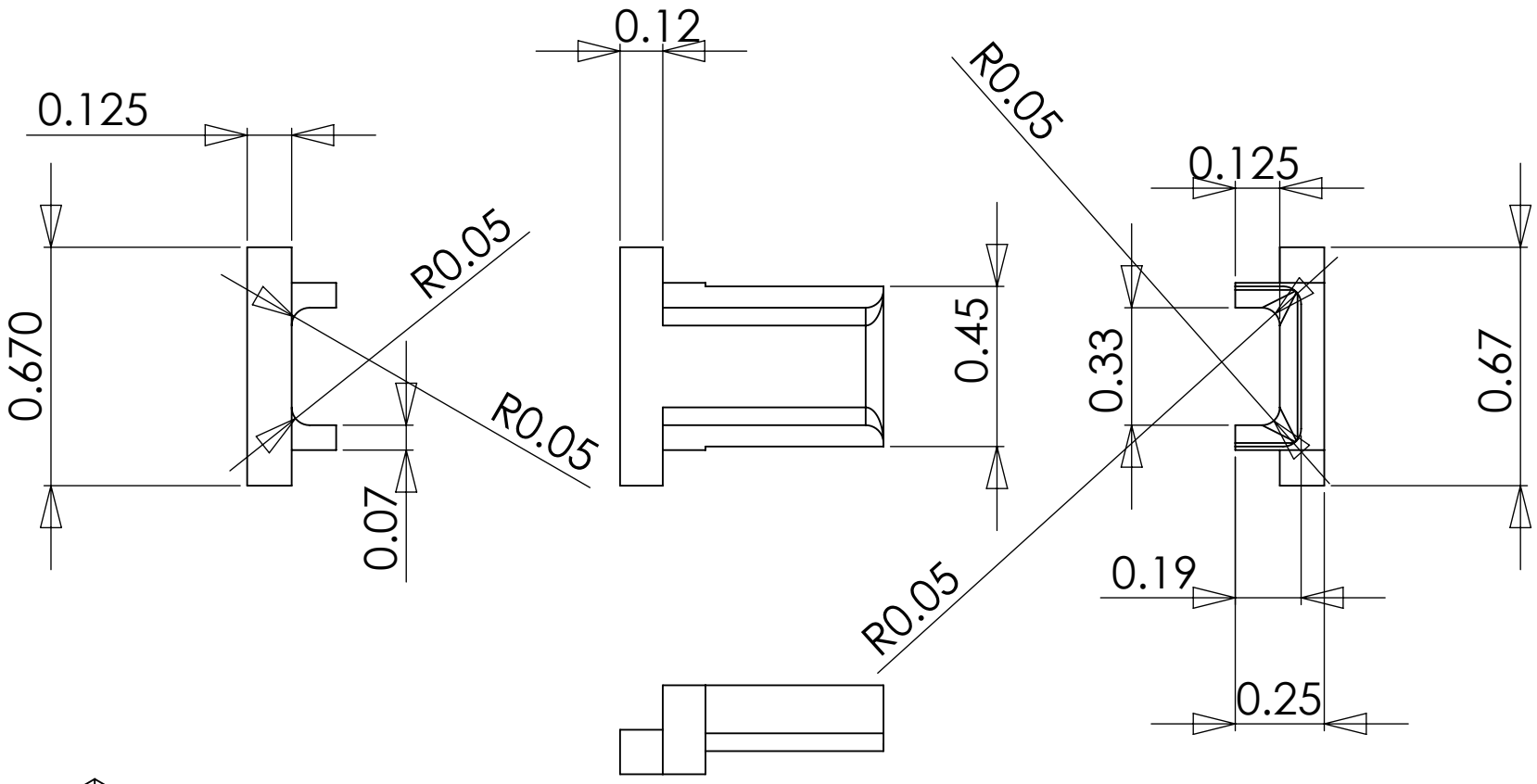

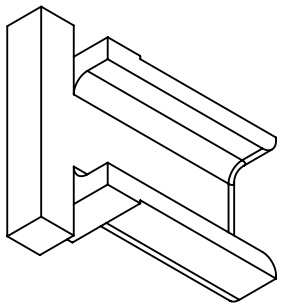

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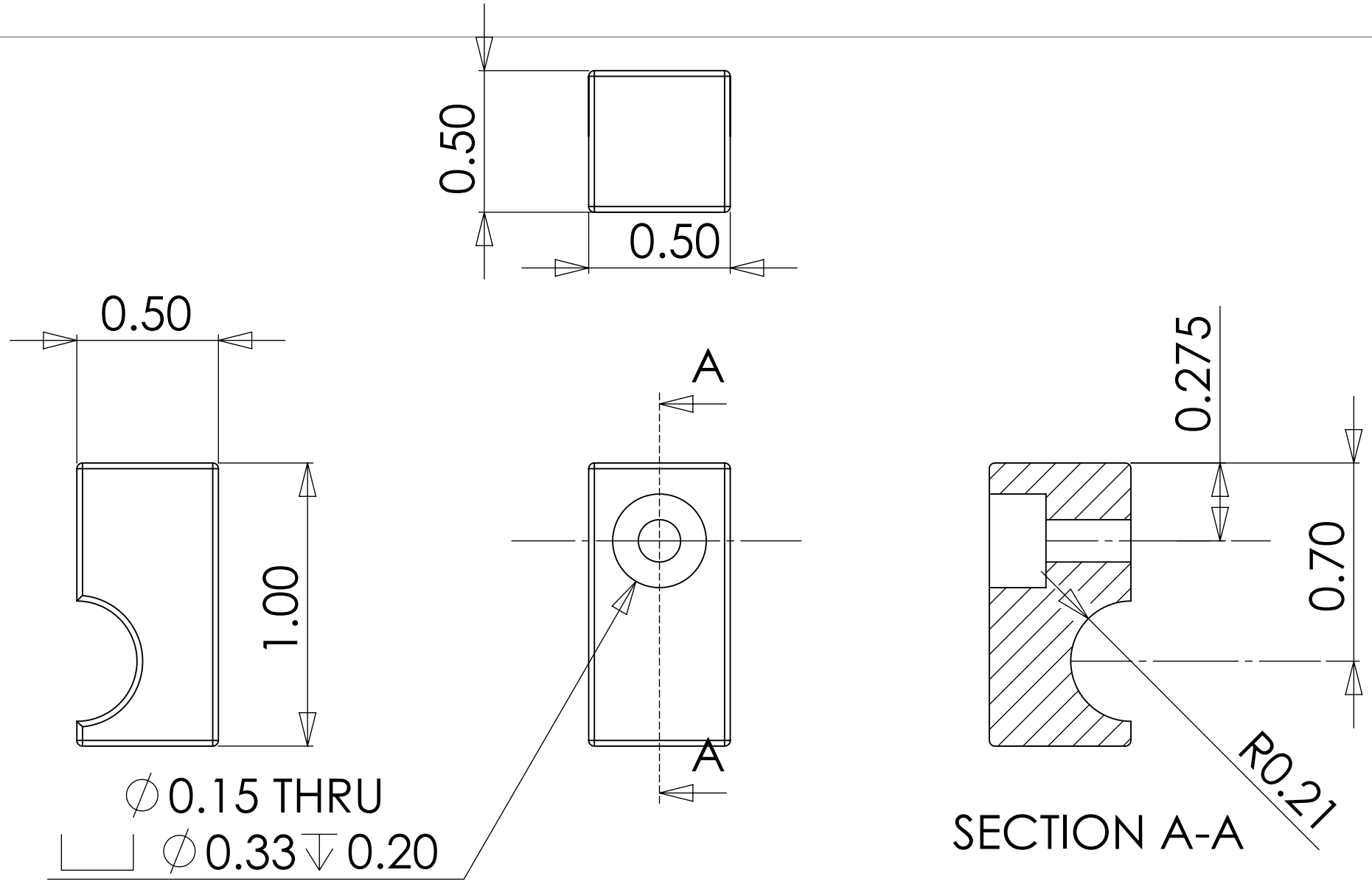
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
NEXT ASSY	USED ON	FINISH --	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

3D print in PLA

snout (removable)

SIZE	DWG. NO.	REV.
A		
SCALE:2:1	WEIGHT:	SHEET 1 OF 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

3D print in PLA

Waste Hose Clamp

SIZE	DWG. NO.	REV.
A		
SCALE:2:1	WEIGHT:	SHEET 1 OF 1

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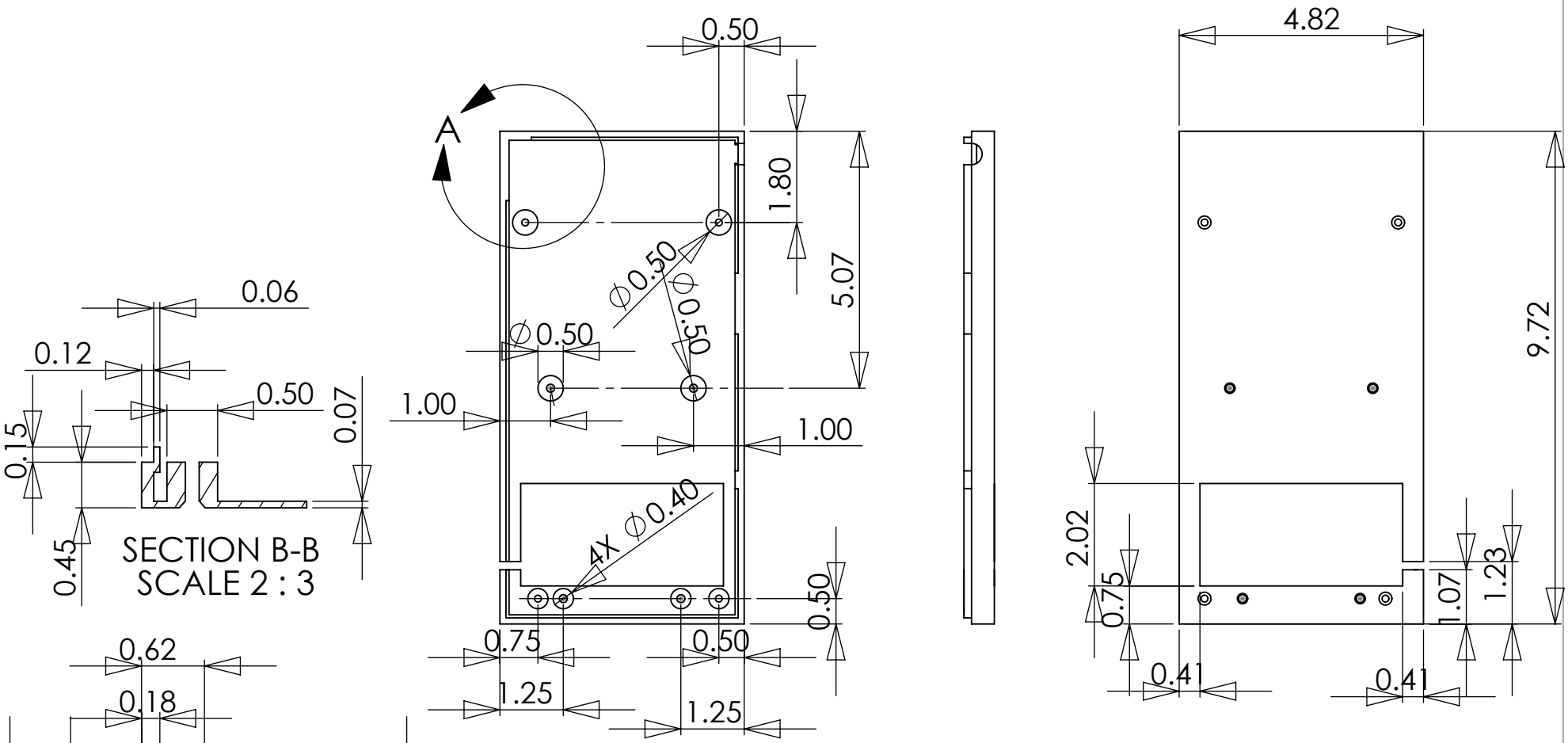

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL --

FINISH --

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

3D Print in PLA

Accessory Box (part 3)
Page 1 or 2

SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 1 OF 2

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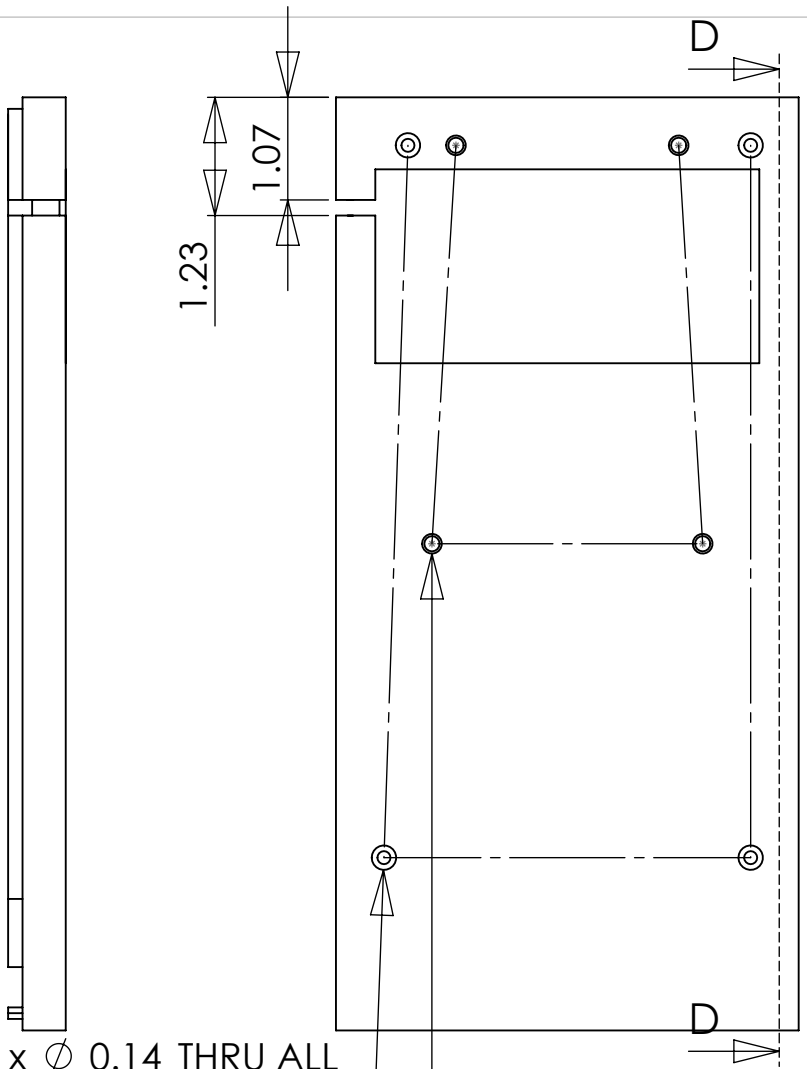
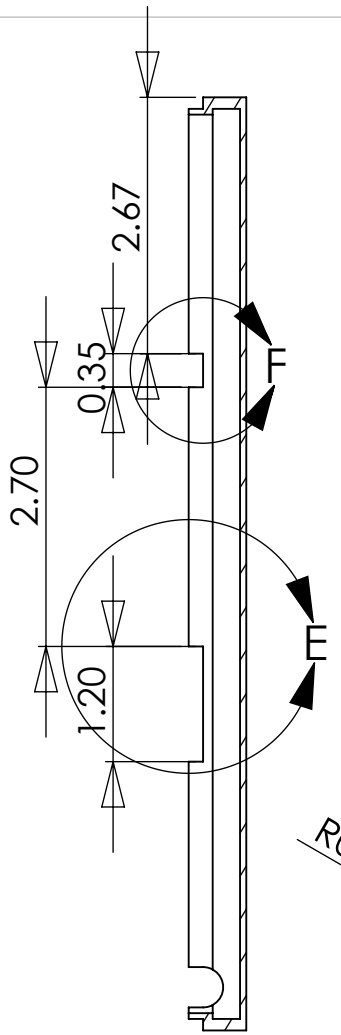
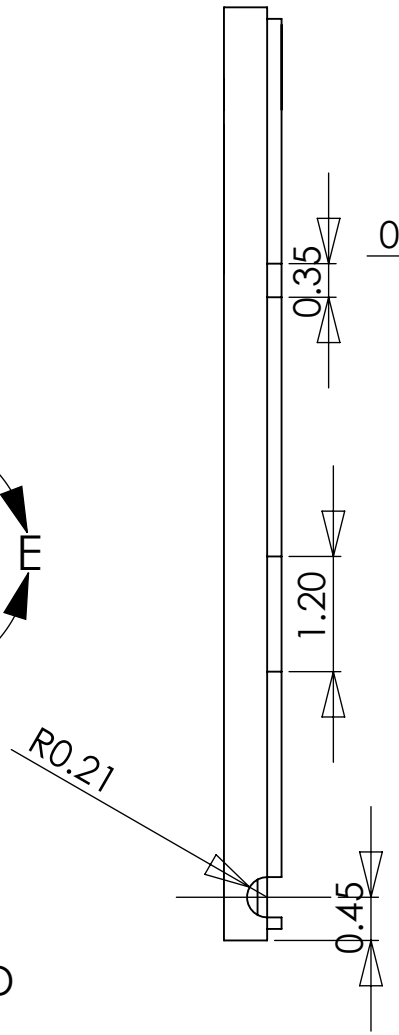


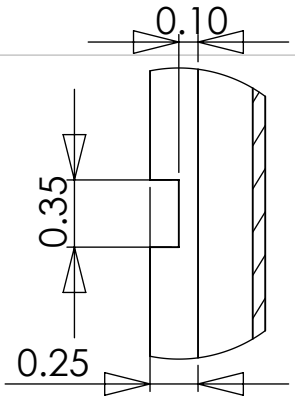
4 x ∅ 0.14 THRU ALL
⌵ ∅ 0.26 X 82°

4x ∅.19 THRU
⌵ ∅0.21 X 6°
Insert 6-32 McMaster-Carr
Part #93365A132

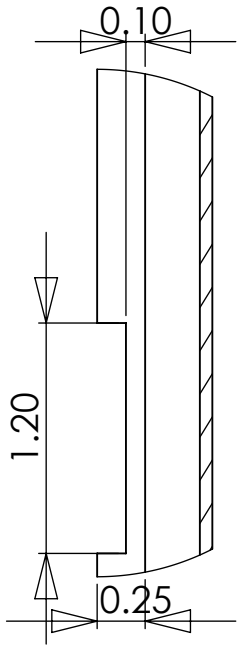


SECTION D-D
SCALE 1 : 2





DETAIL F
SCALE 1 : 1



DETAIL E
SCALE 1 : 1

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Accessory Box (part 3)
Page 2 or 2

SIZE	DWG. NO.	REV
A	Accessory box (part 3)	
SCALE: 1:5	WEIGHT:	SHEET 2 OF 2

5 4 3 2 1

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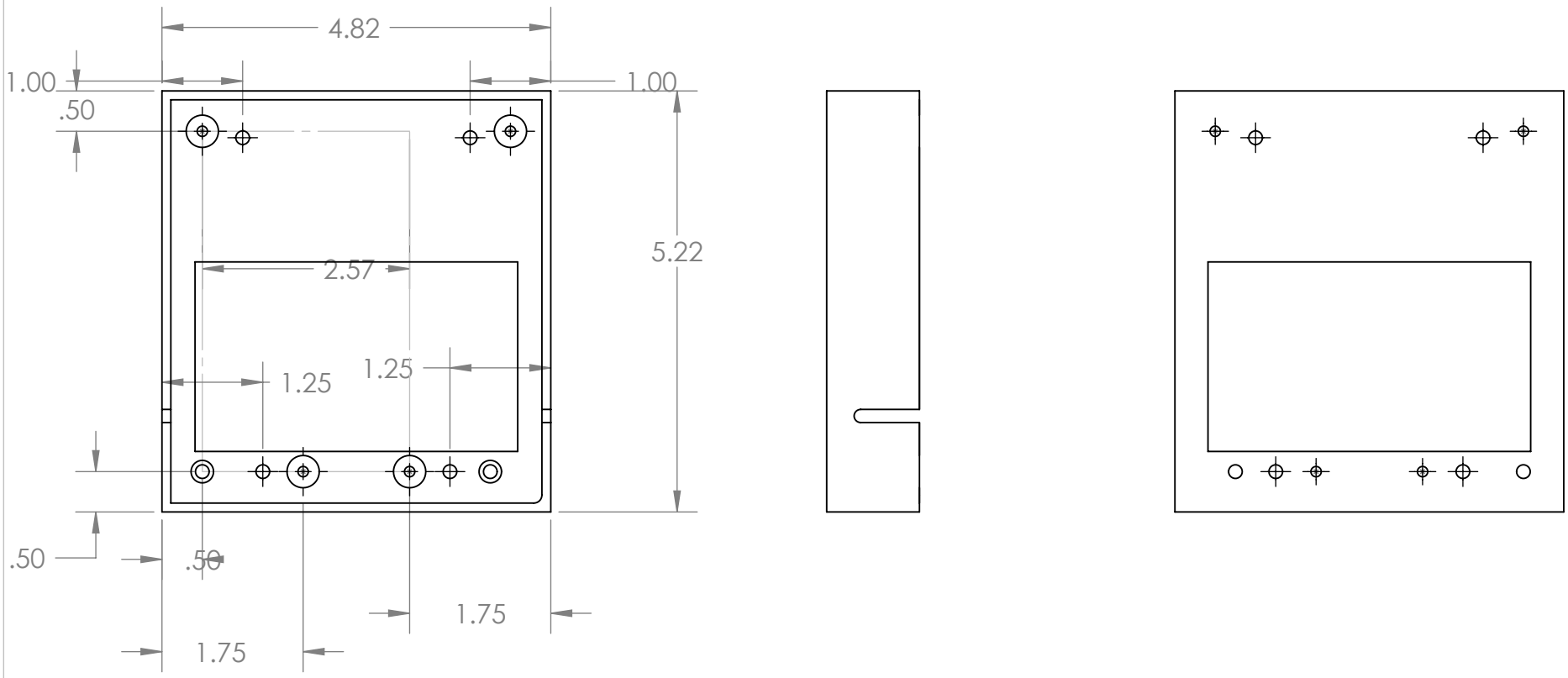

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			CHECKED			
			ENG APPR.			
			MFG APPR.			
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
		MATERIAL	COMMENTS:			SIZE: A; DWG. NO.: Accessory box (part 2); REV:
NEXT ASSY	USED ON	FINISH				
APPLICATION		DO NOT SCALE DRAWING				SCALE: 1:2; WEIGHT:; SHEET 1 OF 1

5 4 3 2 1

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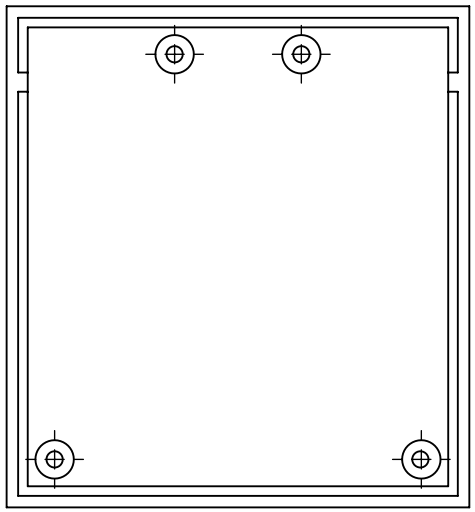

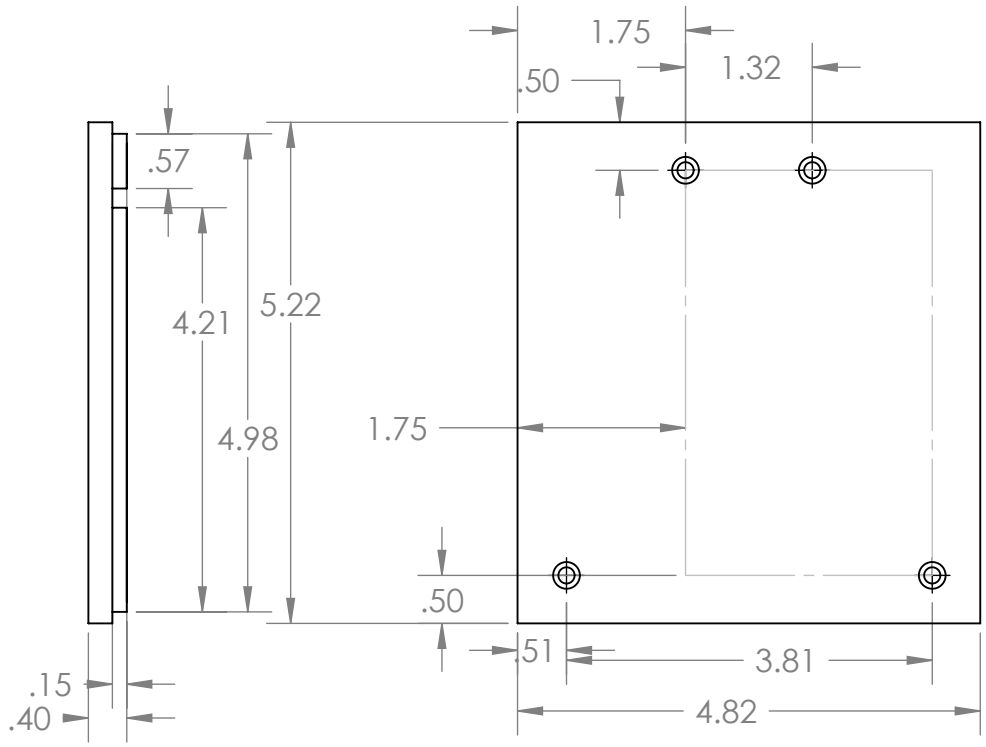

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

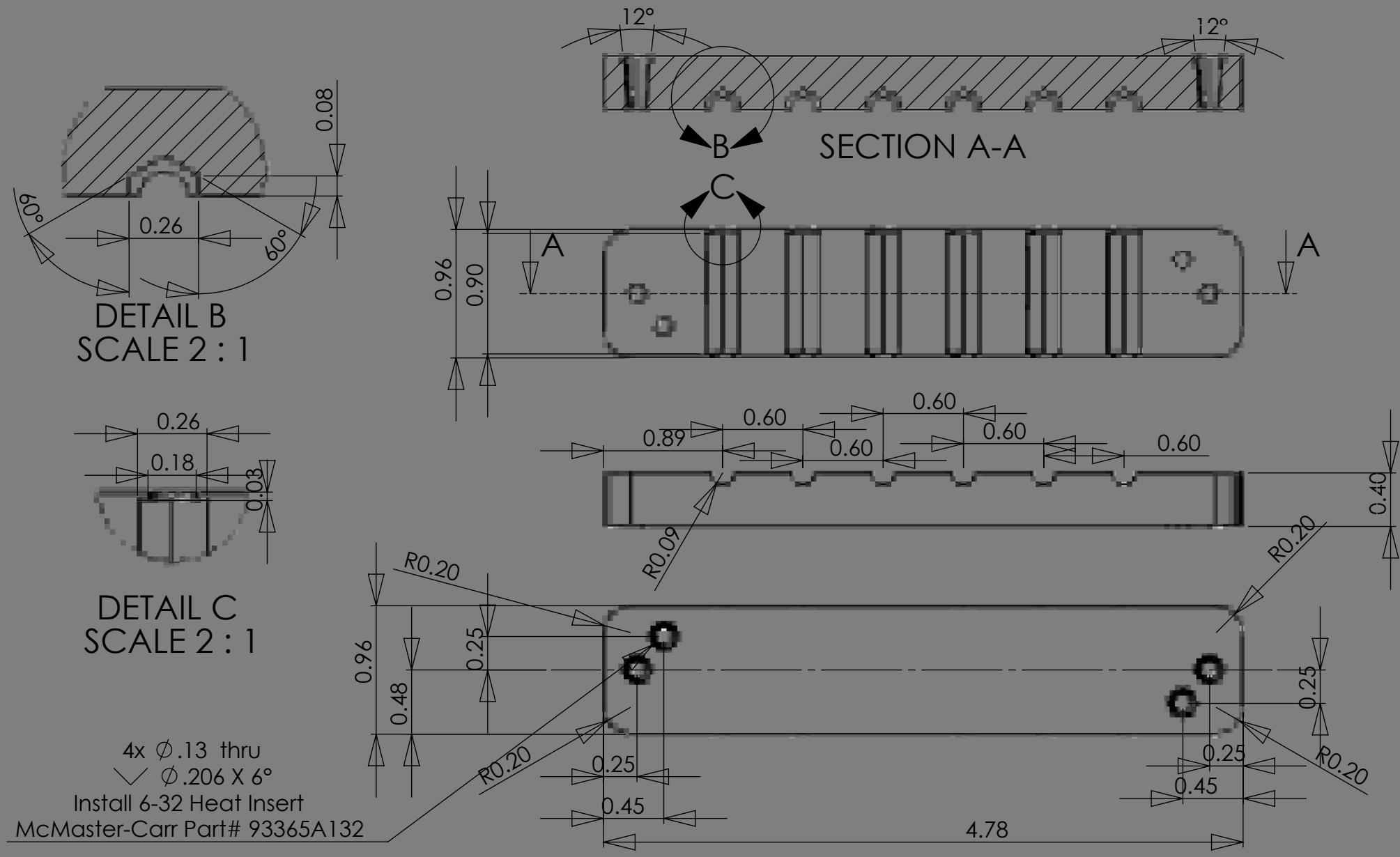
TITLE:

Accessory Box (Part 4)

SIZE	DWG. NO.	REV
A	Accessory box (part 4)	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1

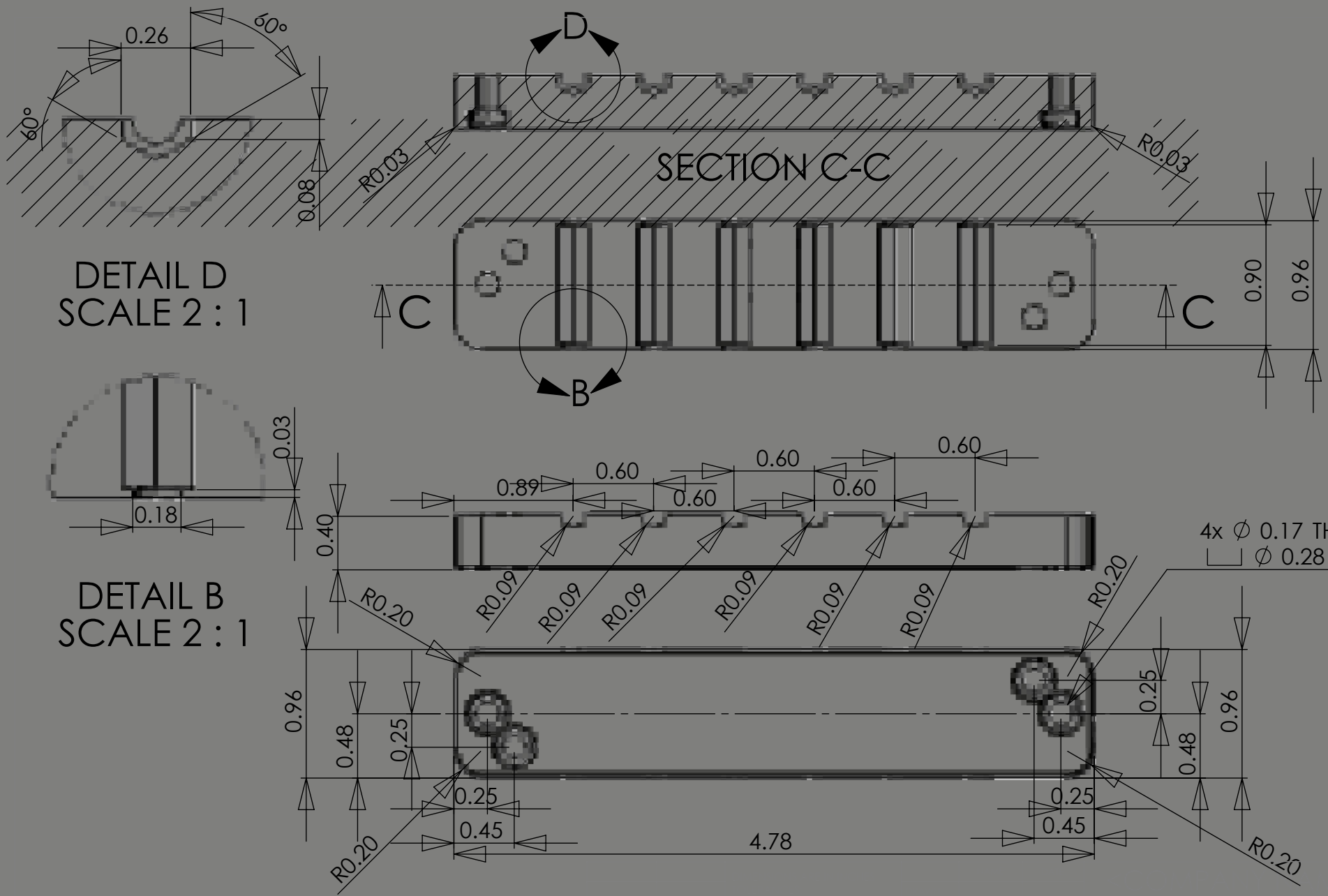
5 4 3 2 1

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Union Holder (Optimize Tech) (Bottom)

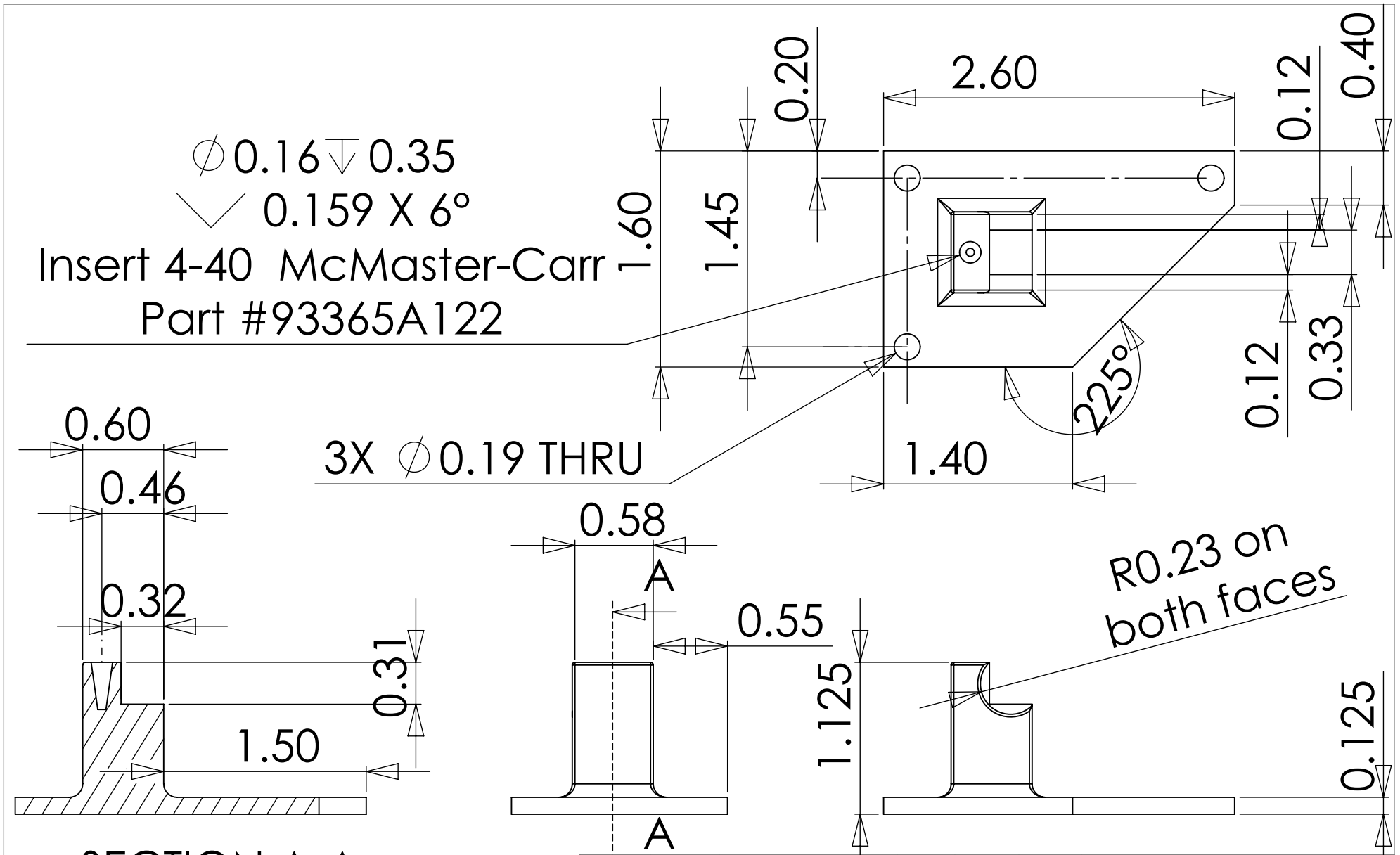
Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



Union Holder (Optimize Tech) (TOP)

COMMENTS:

Dr. Jeffrey W. Hudgens, hudgens@nist.gov, 240-314-6485



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			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

Accessory Mixer Sole Plate

SIZE	DWG. NO.	REV.
A		
SCALE:1:1	WEIGHT:	SHEET 1 OF 1

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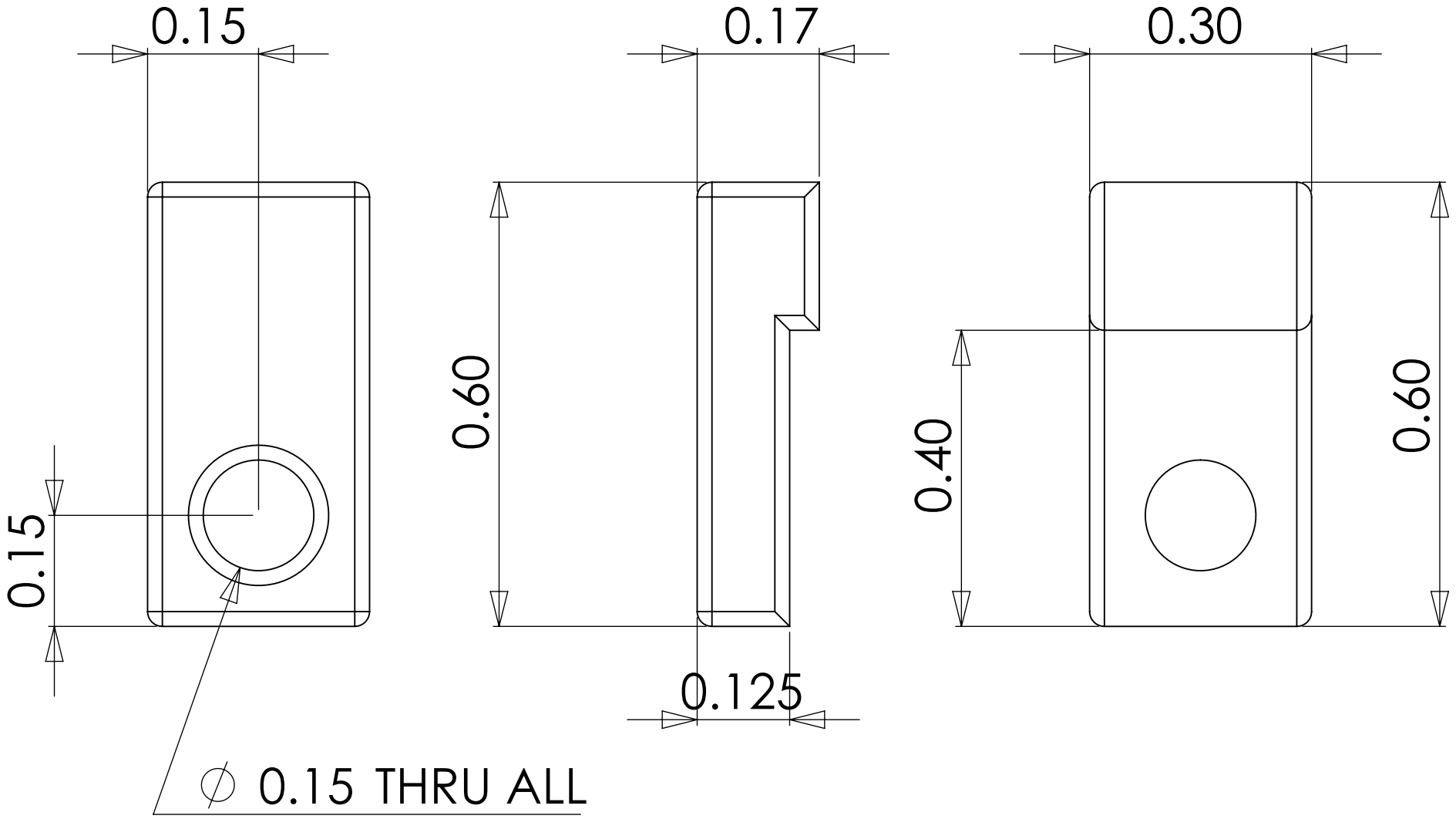

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			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
NEXT ASSY	USED ON	FINISH --	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

Acc Mixer Clamp

SIZE	DWG. NO.	REV.
A		
SCALE:5:1	WEIGHT:	SHEET 1 OF 1

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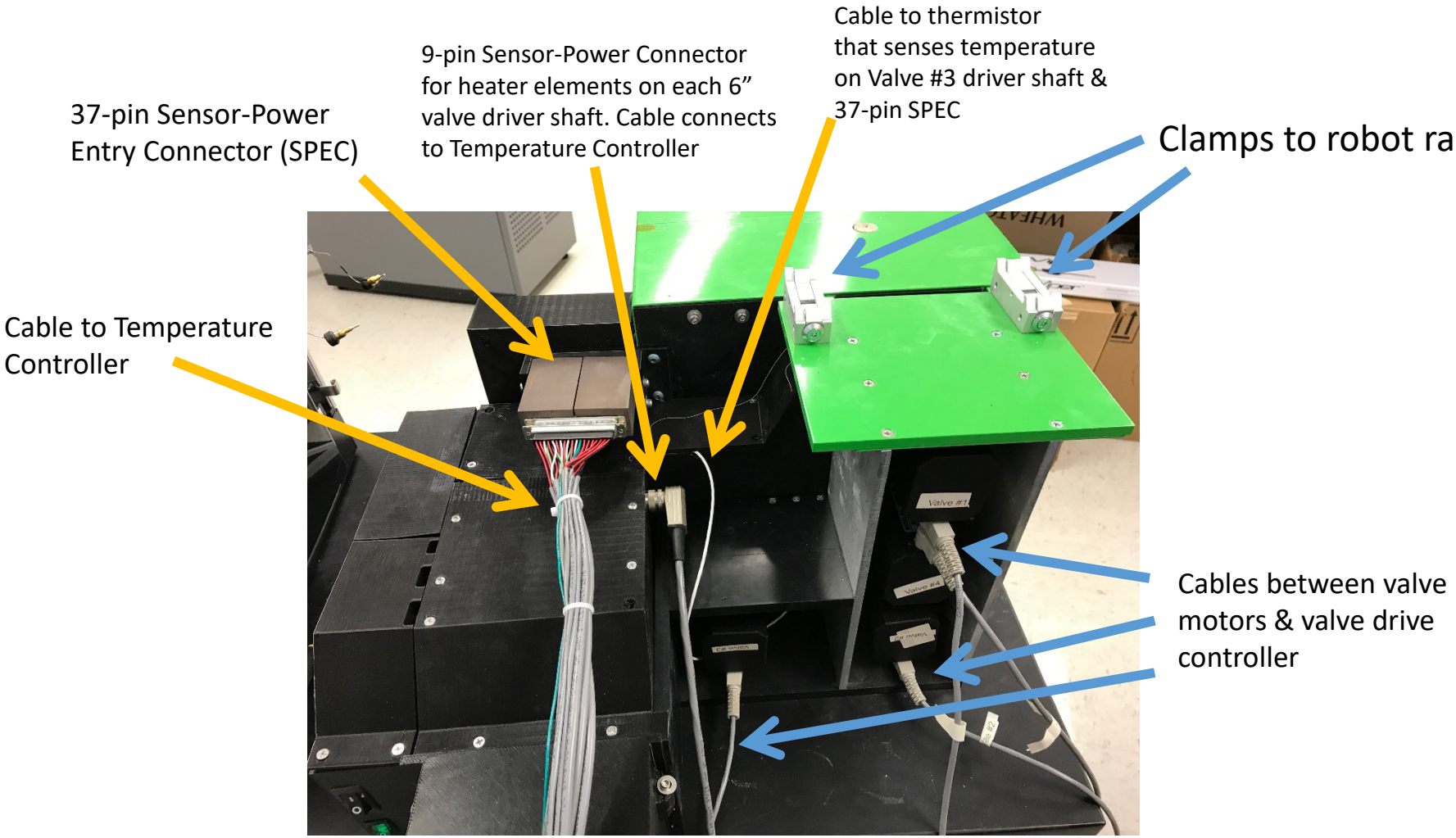
View of Backside Electrical Connections

-- View of an older prototype housing. The connections are same as in the newer housing given in this document.



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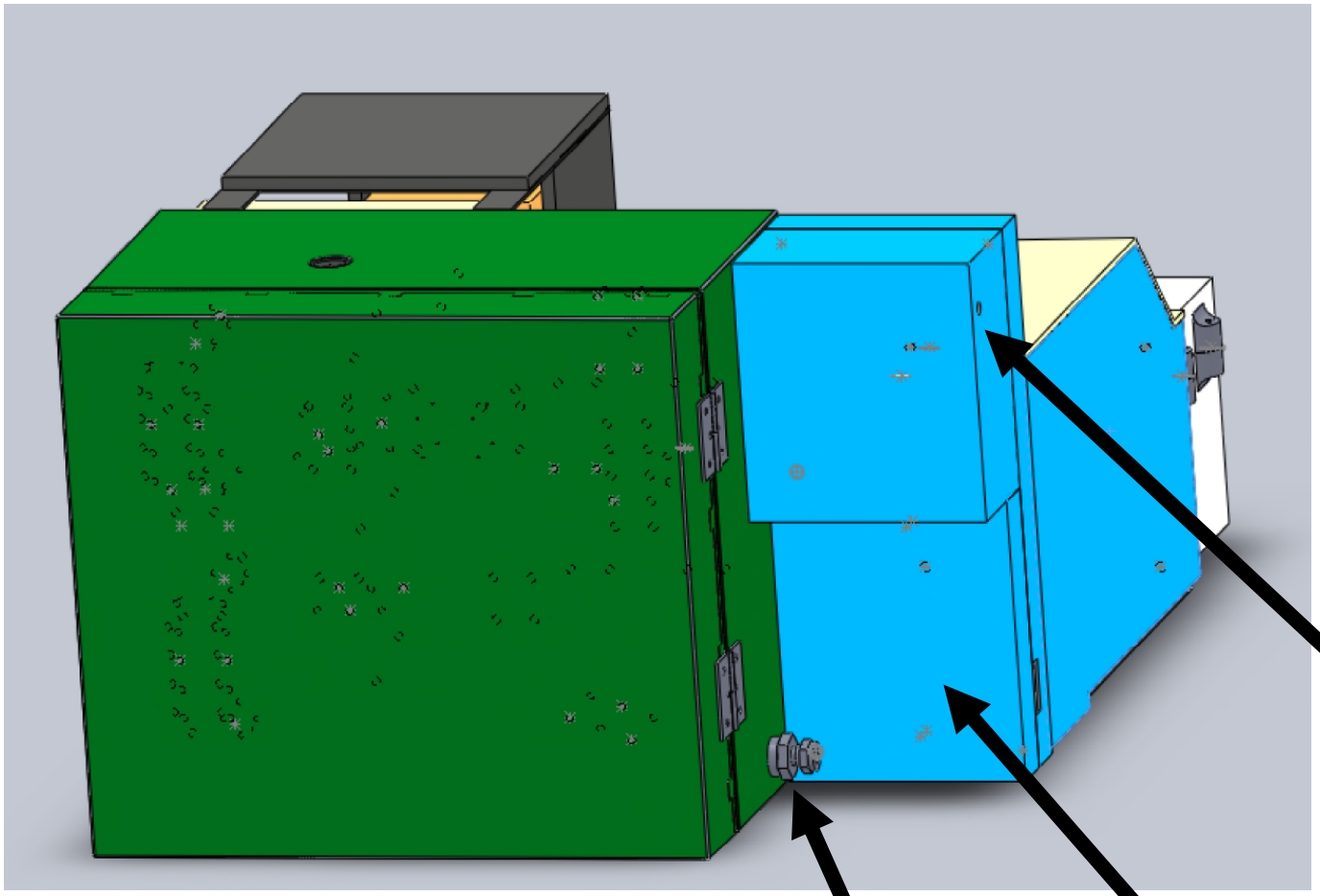
Layout of Box and Accessory Box



Output port to MS. Inside upper box resides the mixer that optimizes ESI efficiency.

Pressurization input here.
Electrical input will likely be just above.

Organizer for fluidic circuits to the six pumps.

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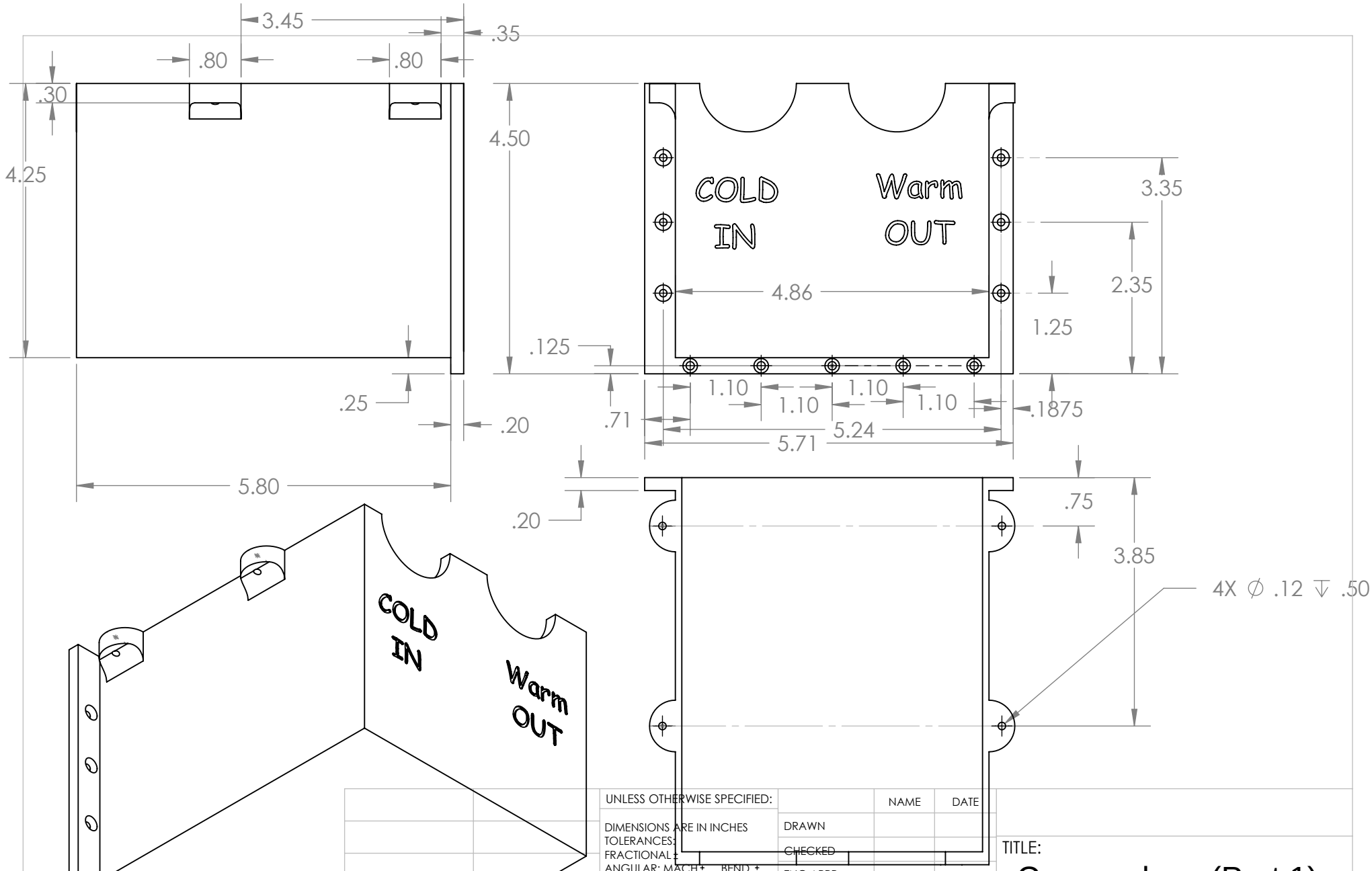

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Cryo-endcap (Part 1)

SIZE	DWG. NO.	REV
A	cryo-endcap part 1	
SCALE: 1:2	WEIGHT:	SHEET 1 OF 1

5 4 3 2 1

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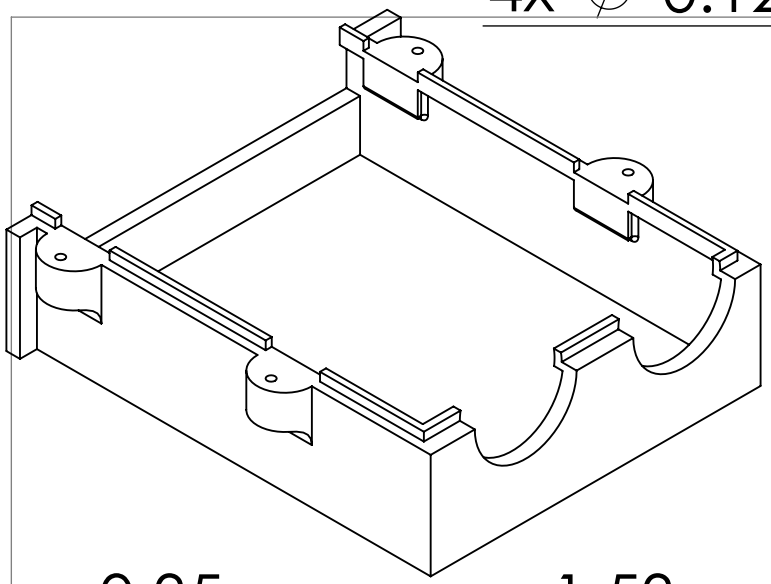

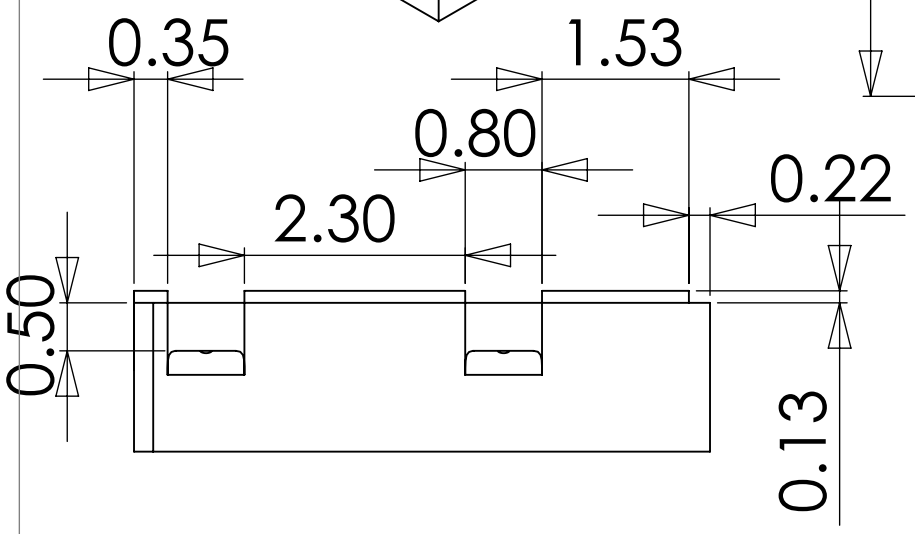

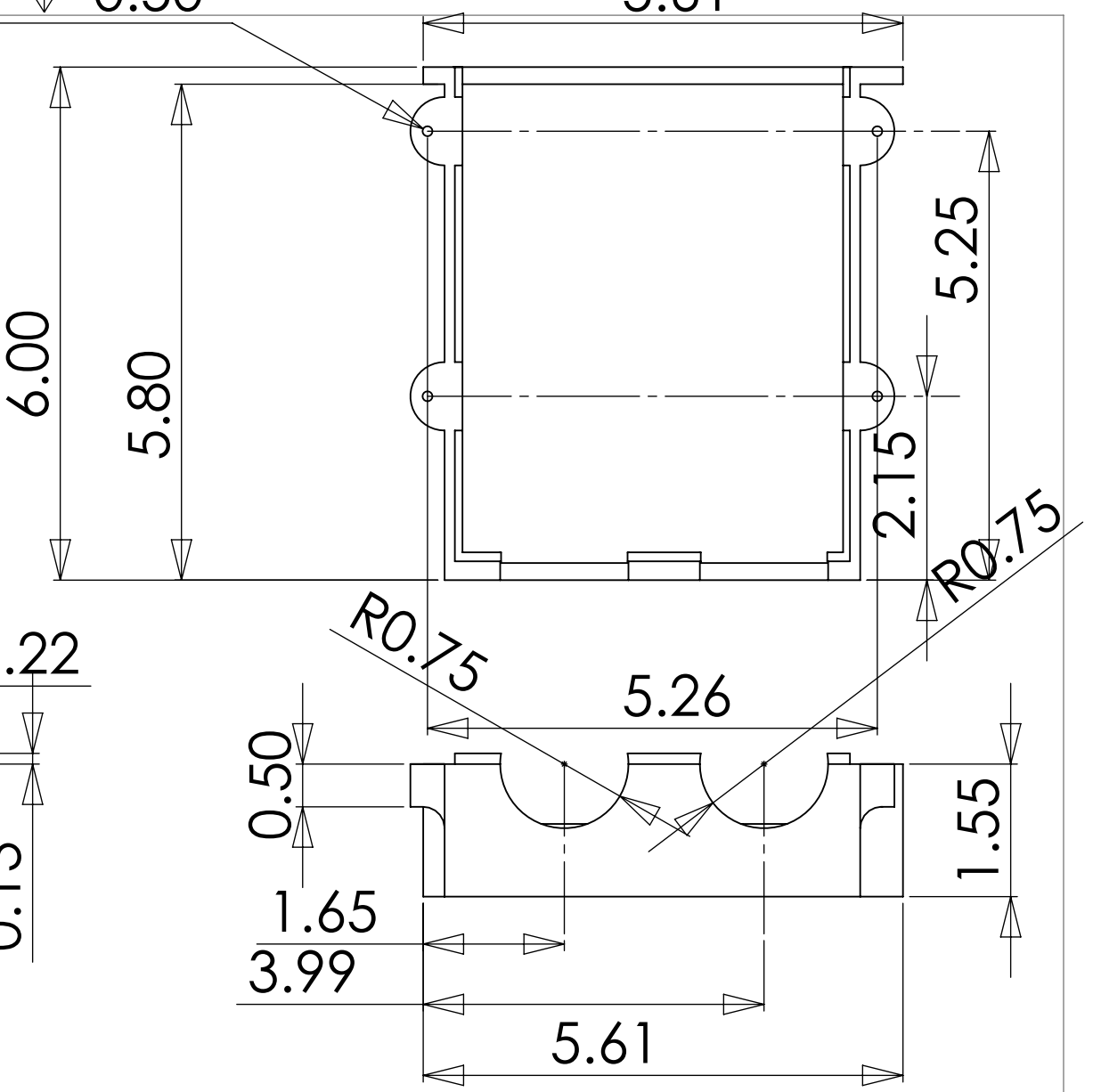

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			DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL --	Q.A.		
NEXT ASSY	USED ON	FINISH --	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

cryo-endcap part 2

SIZE	DWG. NO.	REV.
A		
SCALE:1:2	WEIGHT:	SHEET 1 OF 1

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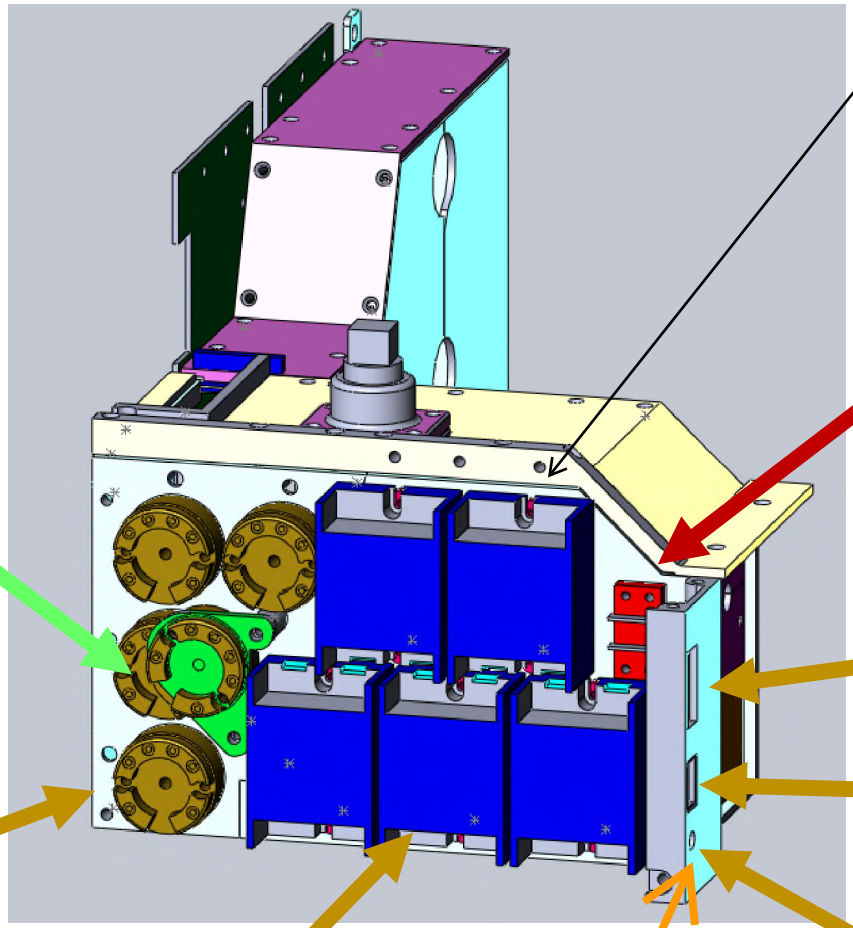
Side View of Housing Showing RTD Circuit Components



To decouple power supply heat, install 2X "Power supply standoff.STL" under each power supply.

1 RTD mounted on RTD Platform

110 VAC barrier strip

Mains Circuit Breaker

Mains Power Switch

4 RTDs mounted on surface

24 DC Power supplies mounted on spacer

Original power entry is shown.

Power Cord enters here. On opposite side affix plastic ties around cord to prevent pullout.

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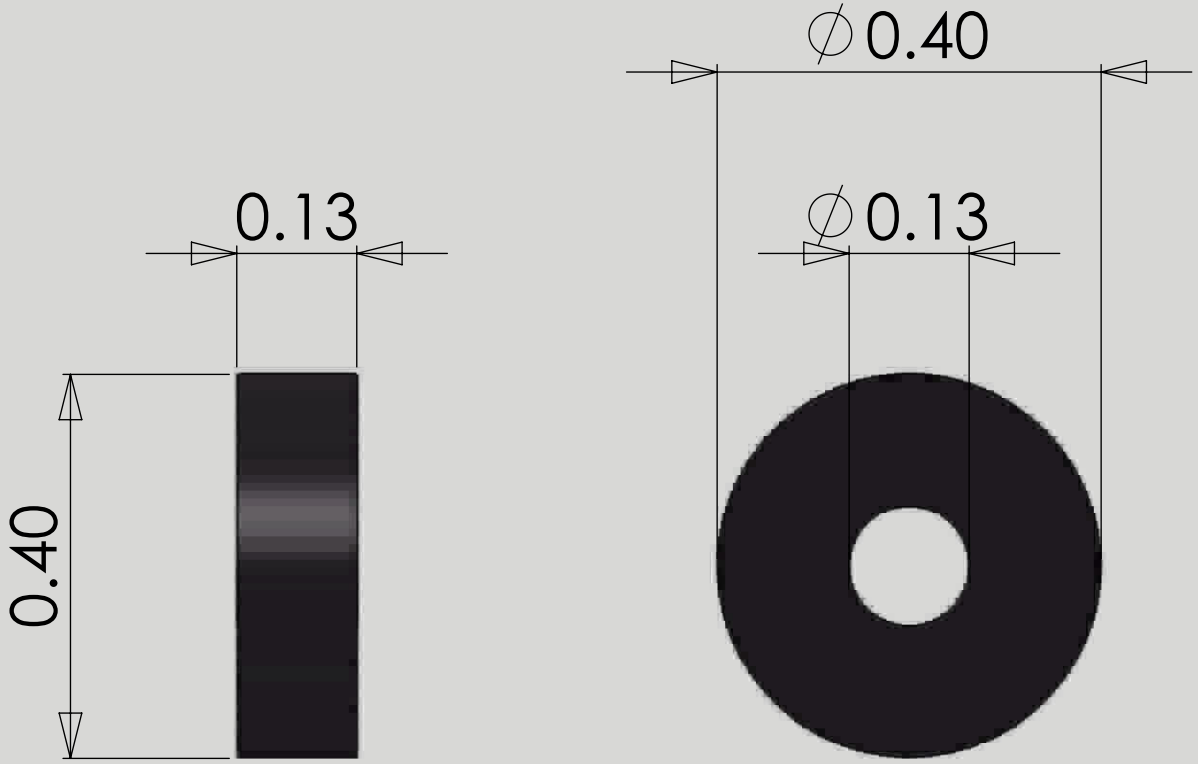

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL --	COMMENTS:		
NEXT ASSY	USED ON	FINISH --			
APPLICATION		DO NOT SCALE DRAWING			

<COMPANY NAME>

Power supply standoff

SIZE	DWG. NO.	REV.
A		
SCALE:5:1	WEIGHT:	SHEET 1 OF 1

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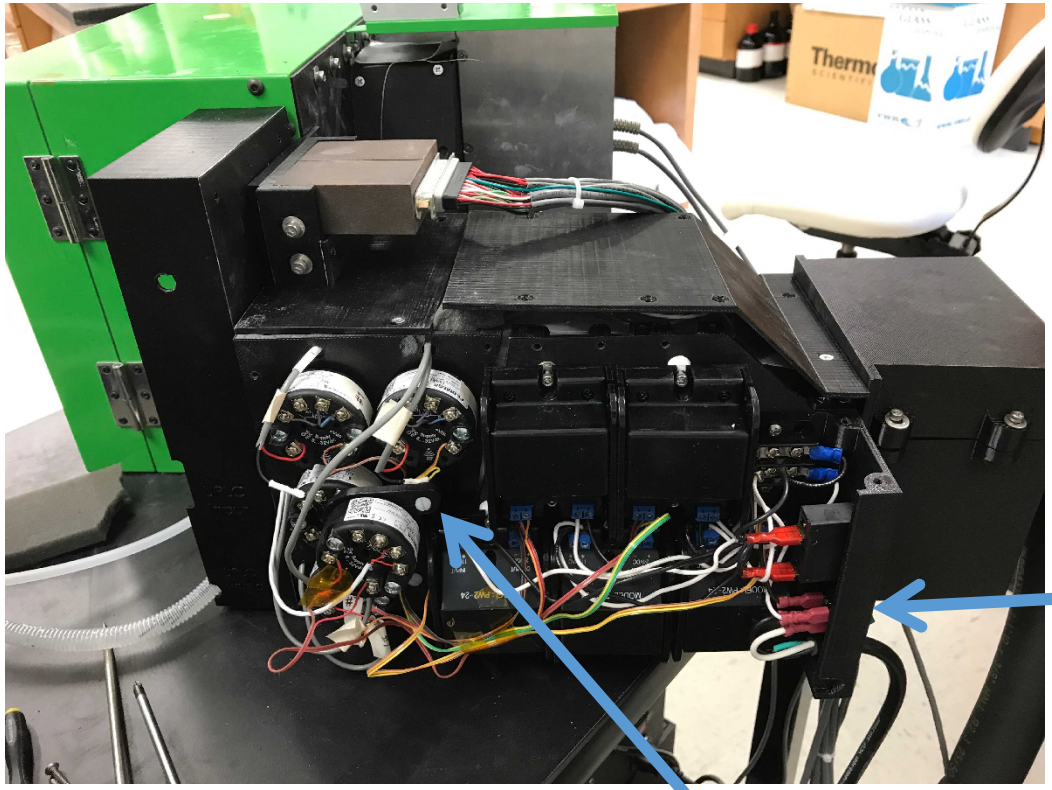
View of the RTD Electronics

-- Photo is of an older prototype housing.



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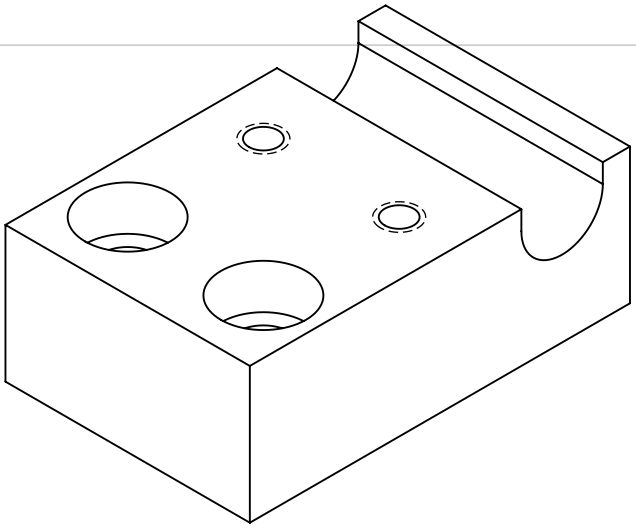

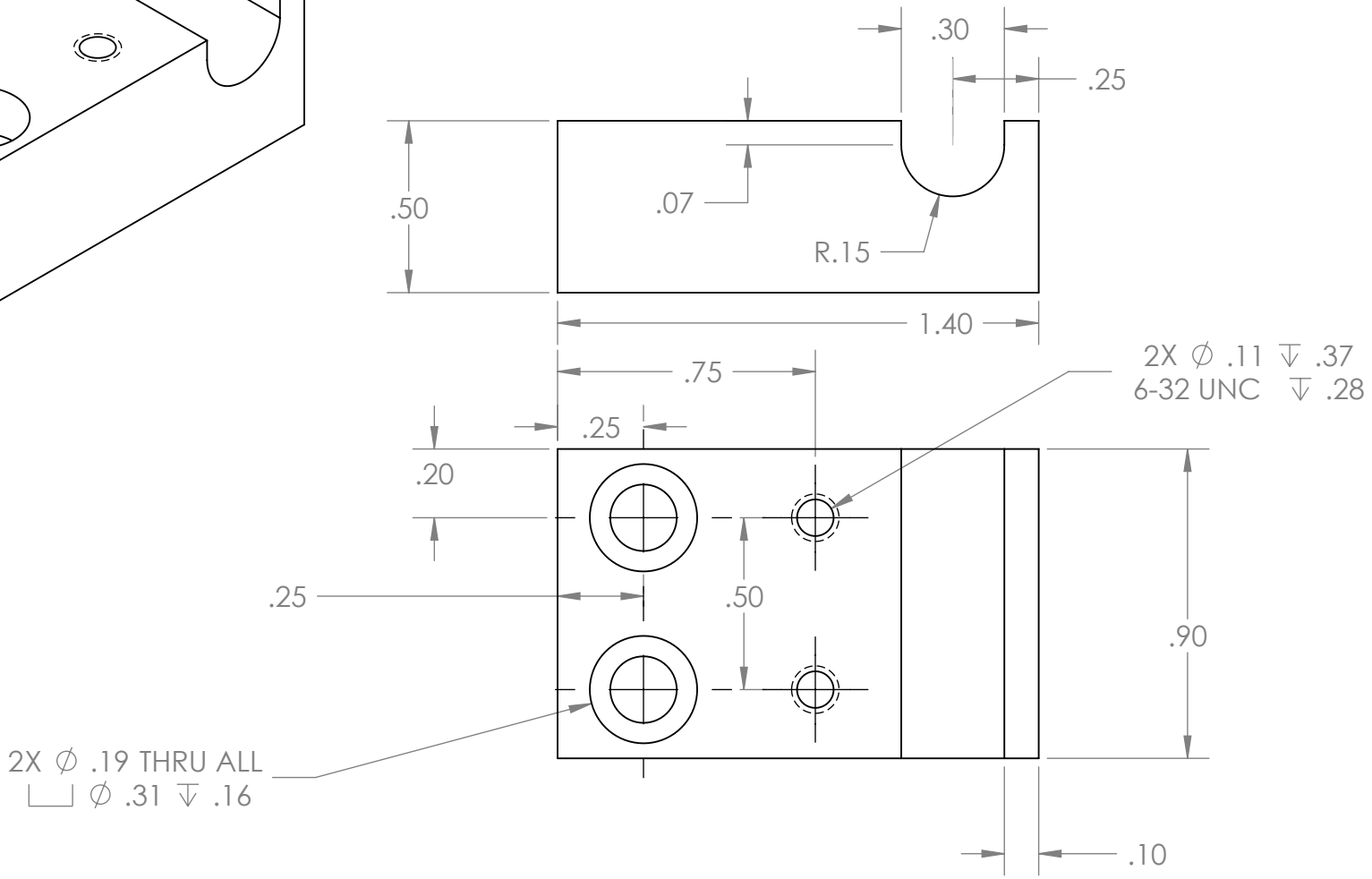

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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE:
HPLC Column Clamp
(Part 1)
[JWH: 4-10-2016]

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

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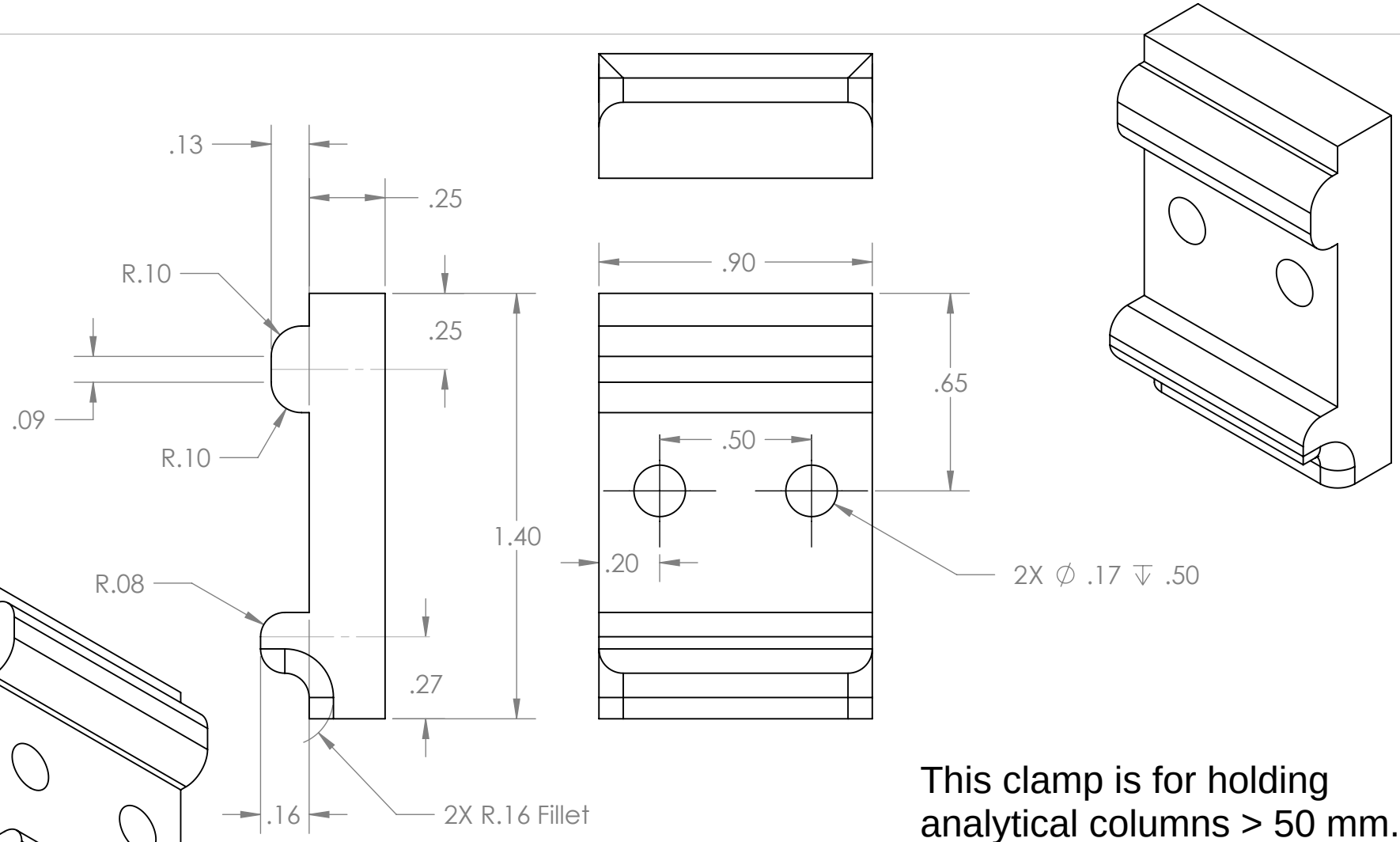

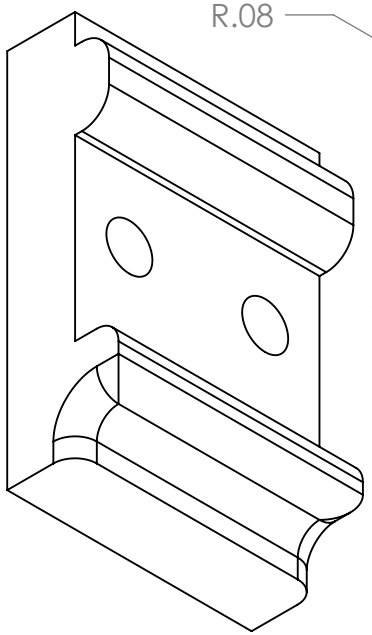

This clamp is for holding analytical columns > 50 mm.

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±	DRAWN		
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

Material: 6061 AL

TITLE: HPLC Column Clamp (Part 2) [JWH: 4-1-2016]

SIZE	DWG. NO.	REV
A		

SCALE: 2:1 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

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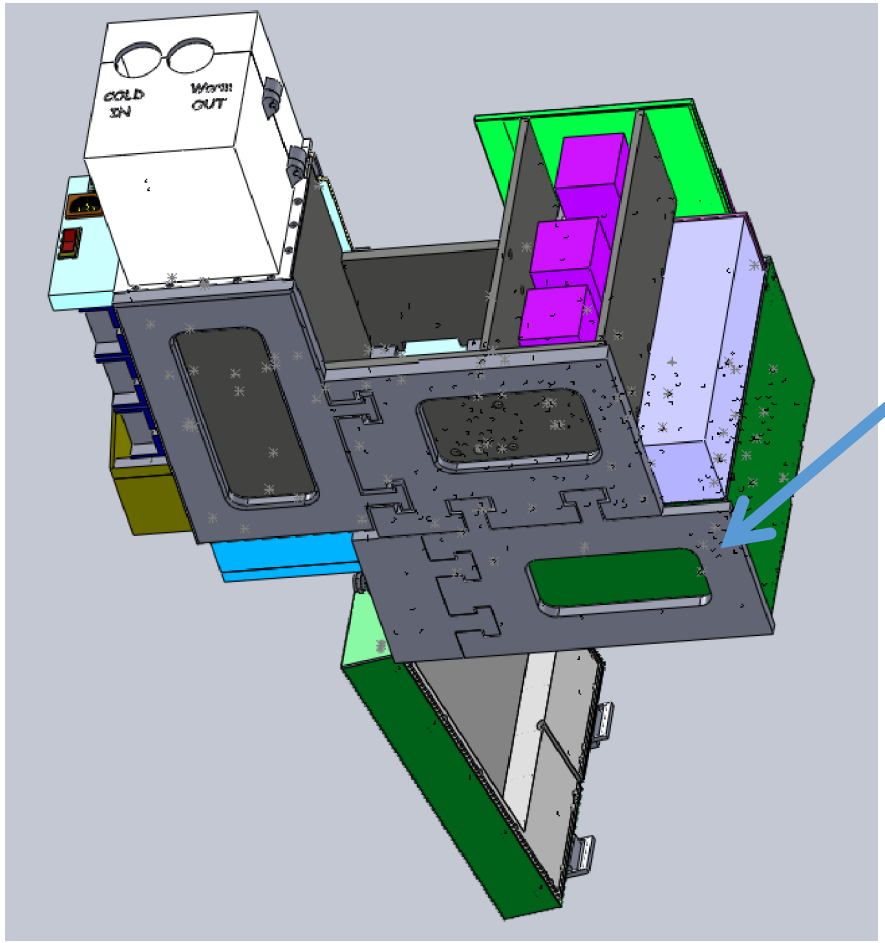
Complete Assembly including Elevation Compensation



Four STL files are included that will raise box by 0.50”.

Elevation can be changed using 3D-printer slicing software that allows z-axis scaling.

See note on assembly drawing for additional information.

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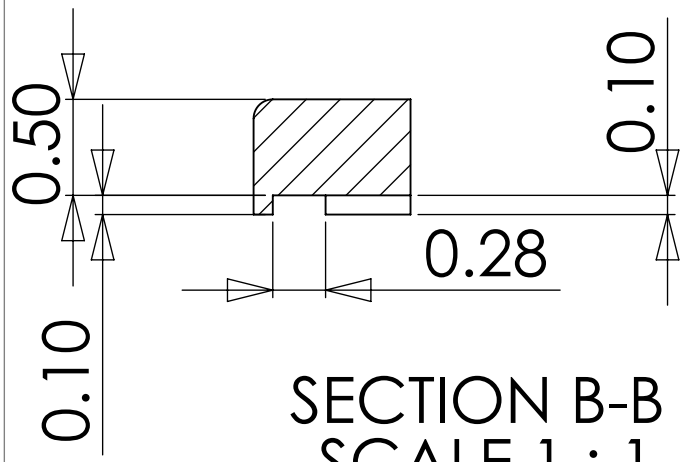
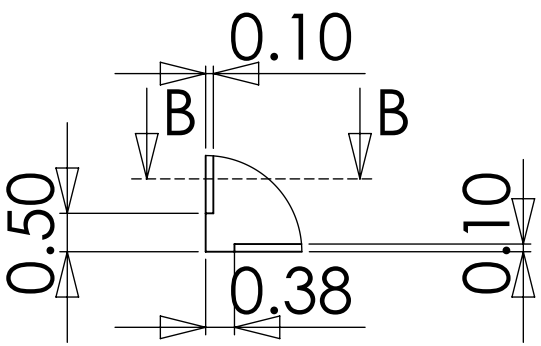
NOTE: The green box is 0.5" shorter than our original orange box, so we printed this spacer assembly. The four *"BASE_HPLC_#.STL"* files shown here reside in the STL file directory. However, you will need to write your own files to accomdate other elevations.

When designing a base, you want the pieces to fit tightly, so that they clinge together during handling.

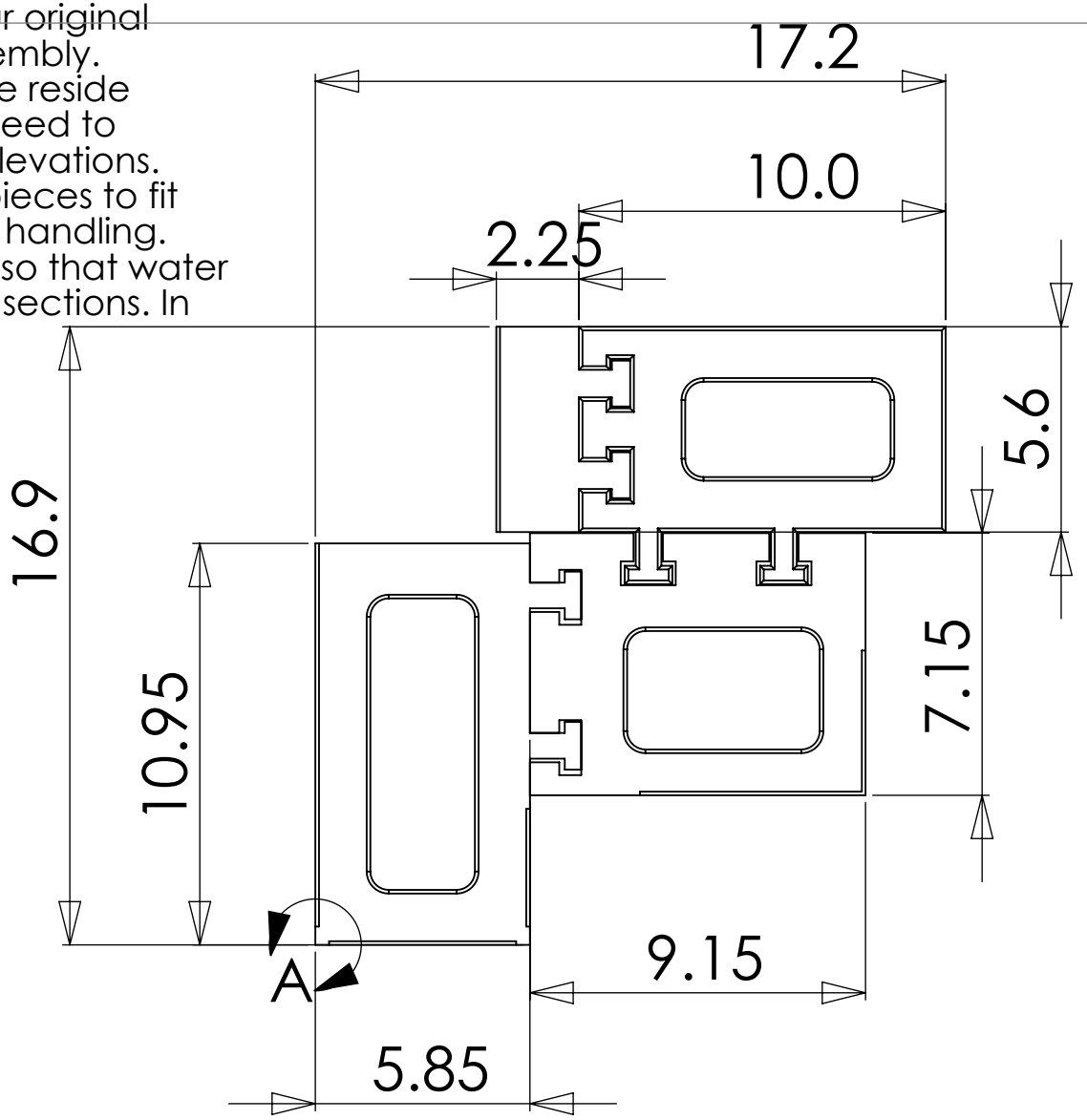
Provide channels and breaks in the lips, so that water can flow out during defrosting of the -30C sections. In a perfect world, the dry gas purging will prevent such frosting.



SECTION B-B
SCALE 1 : 1



DETAIL A
SCALE 2 : 5



NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL --

FINISH --

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

3D Print in PLA

HPLC Base Assembly

SIZE	DWG. NO.	REV.
A		
SCALE:1:5	WEIGHT:	SHEET 1 OF 1

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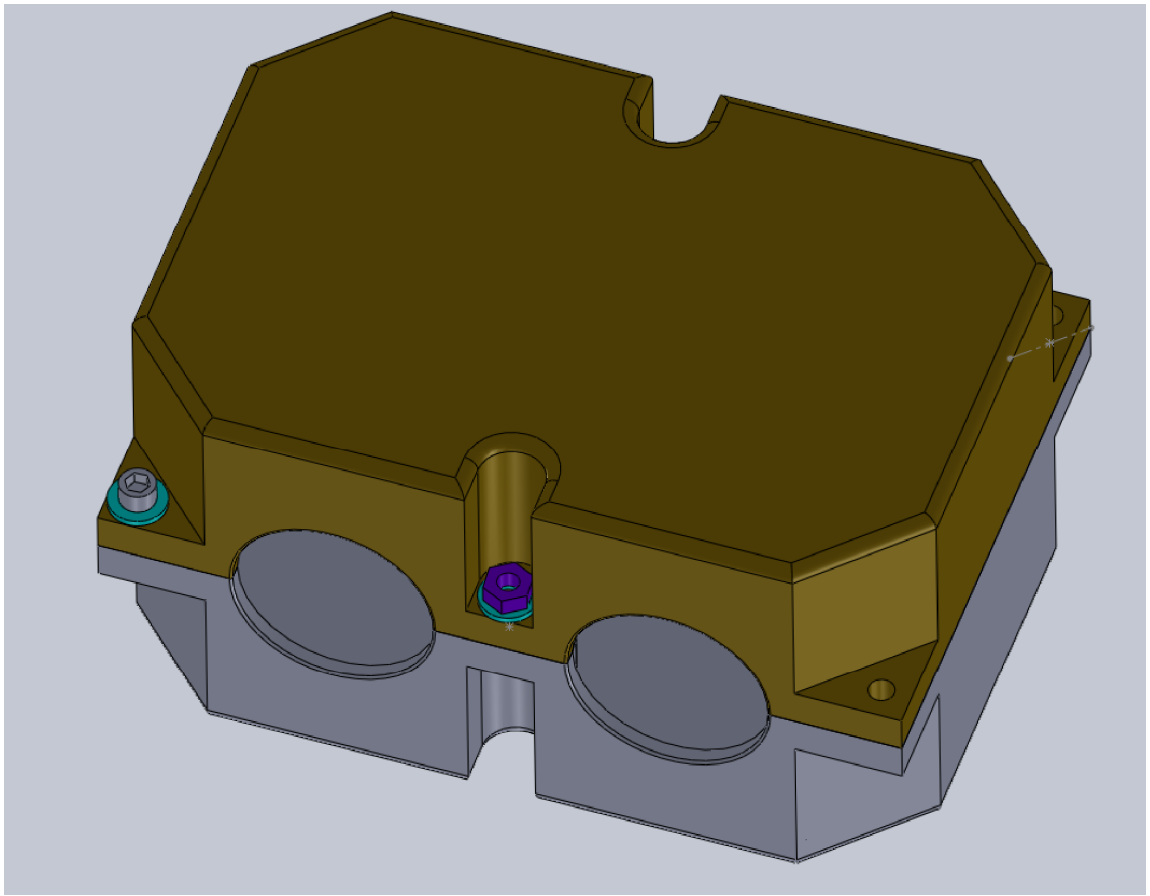
Auxiliary Insulation Used at the Cooler-Hose Connection



Pack case with insulation and clamp around the cooler hose connections using 8-32 screw/washer/nut sets.

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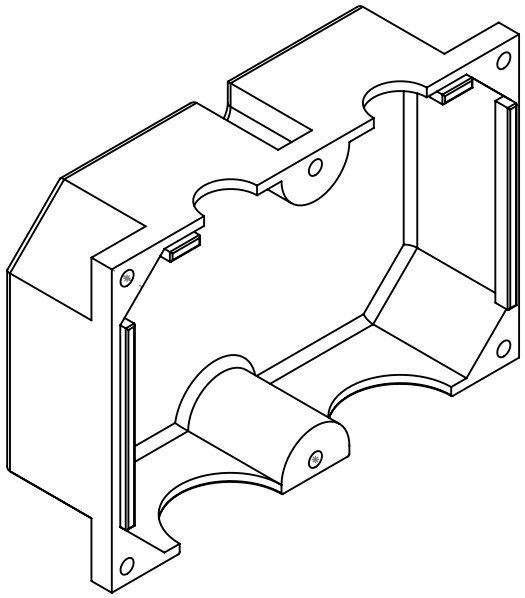

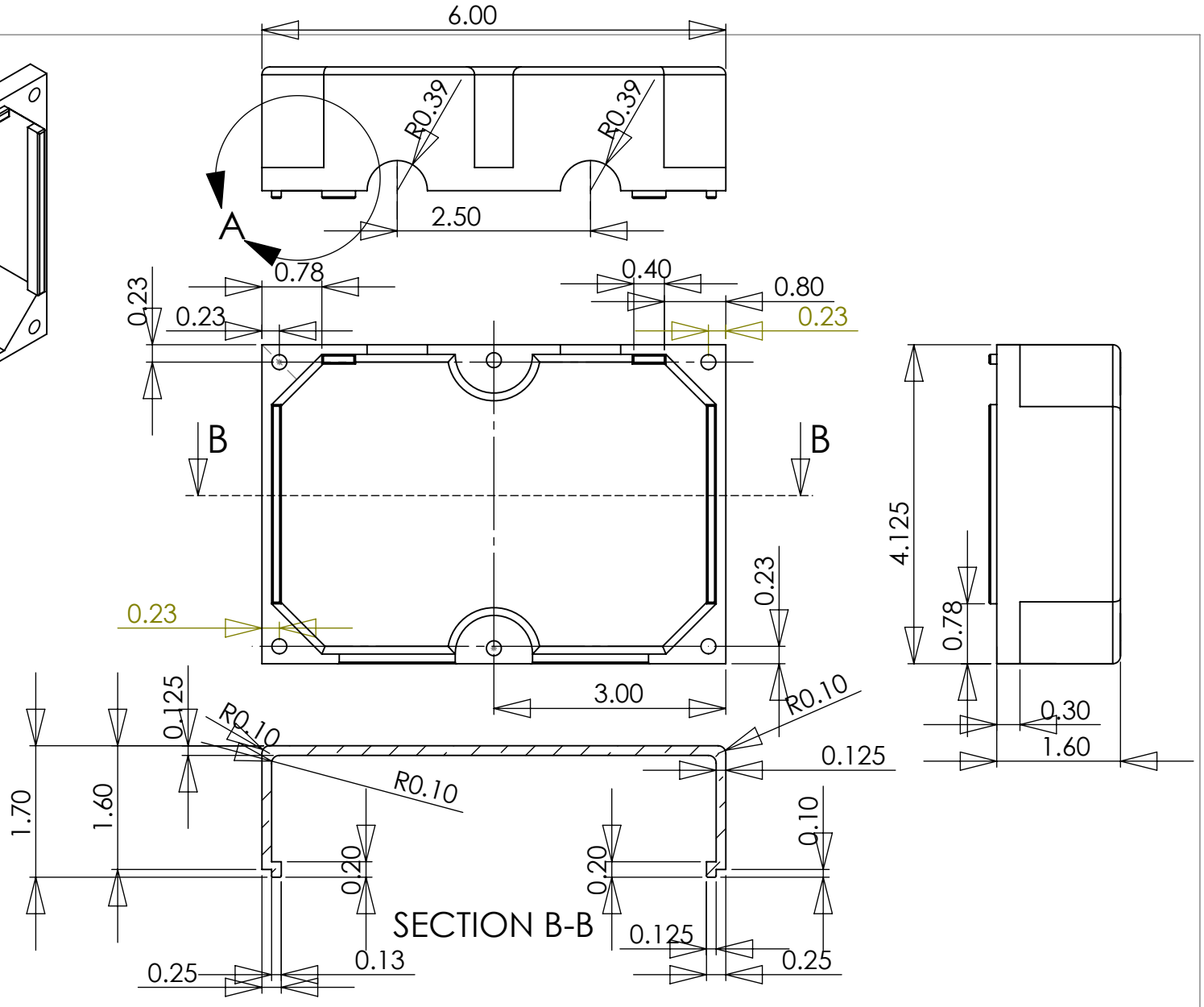

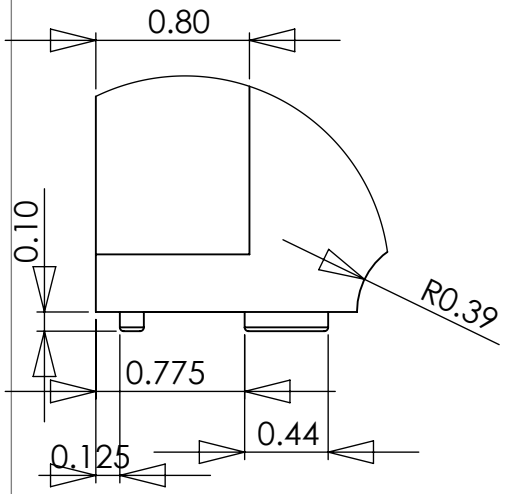

DETAIL A
SCALE 1 : 1

NEXT ASSY	USED ON
APPLICATION	

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL --

FINISH --

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

3D Print in PLA

Cooler outlet box (top)
page 1 of 2

SIZE	DWG. NO.	REV.
A		
SCALE:1:2	WEIGHT:	SHEET 1 OF 2

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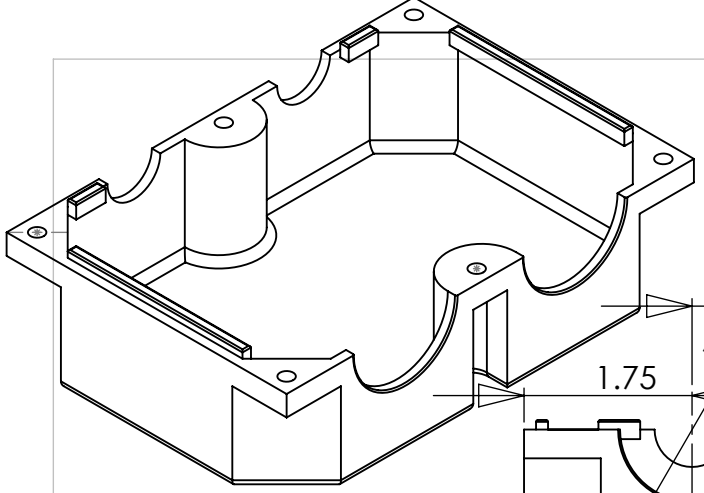

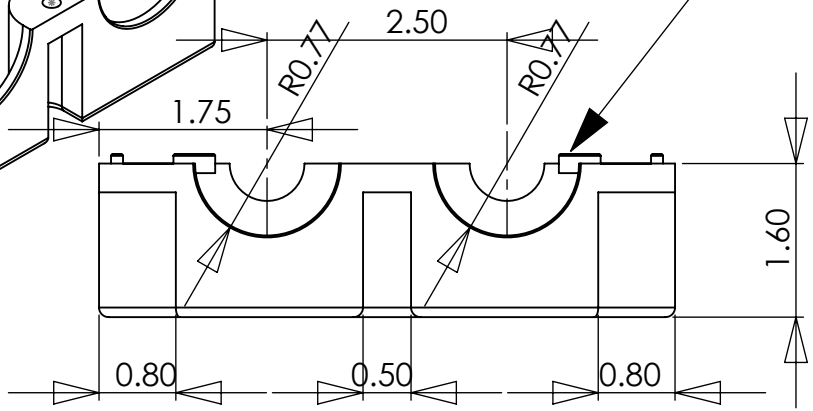

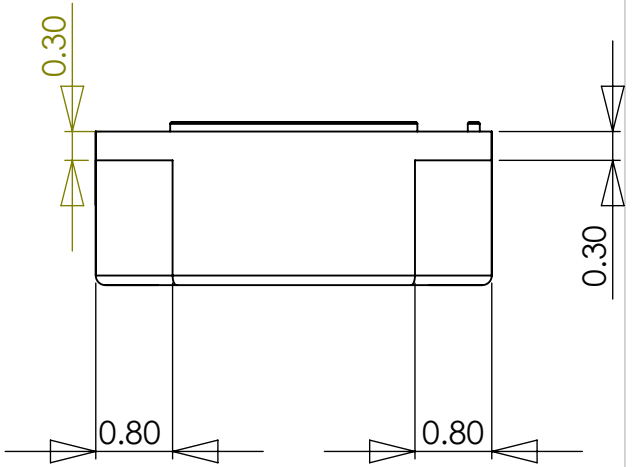

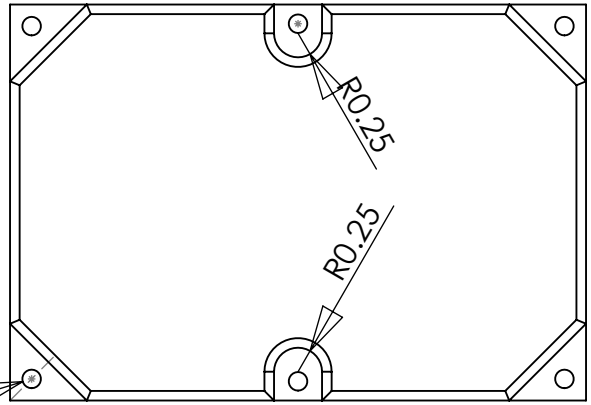

6X ∅ 0.19 THRU ALL

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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			CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

TITLE:
Cooler outlet box (top)
page 2 of 2

SIZE	DWG. NO.	REV
A		
SCALE: 1:2	WEIGHT:	SHEET 2 OF 2

5 4 3 2 1

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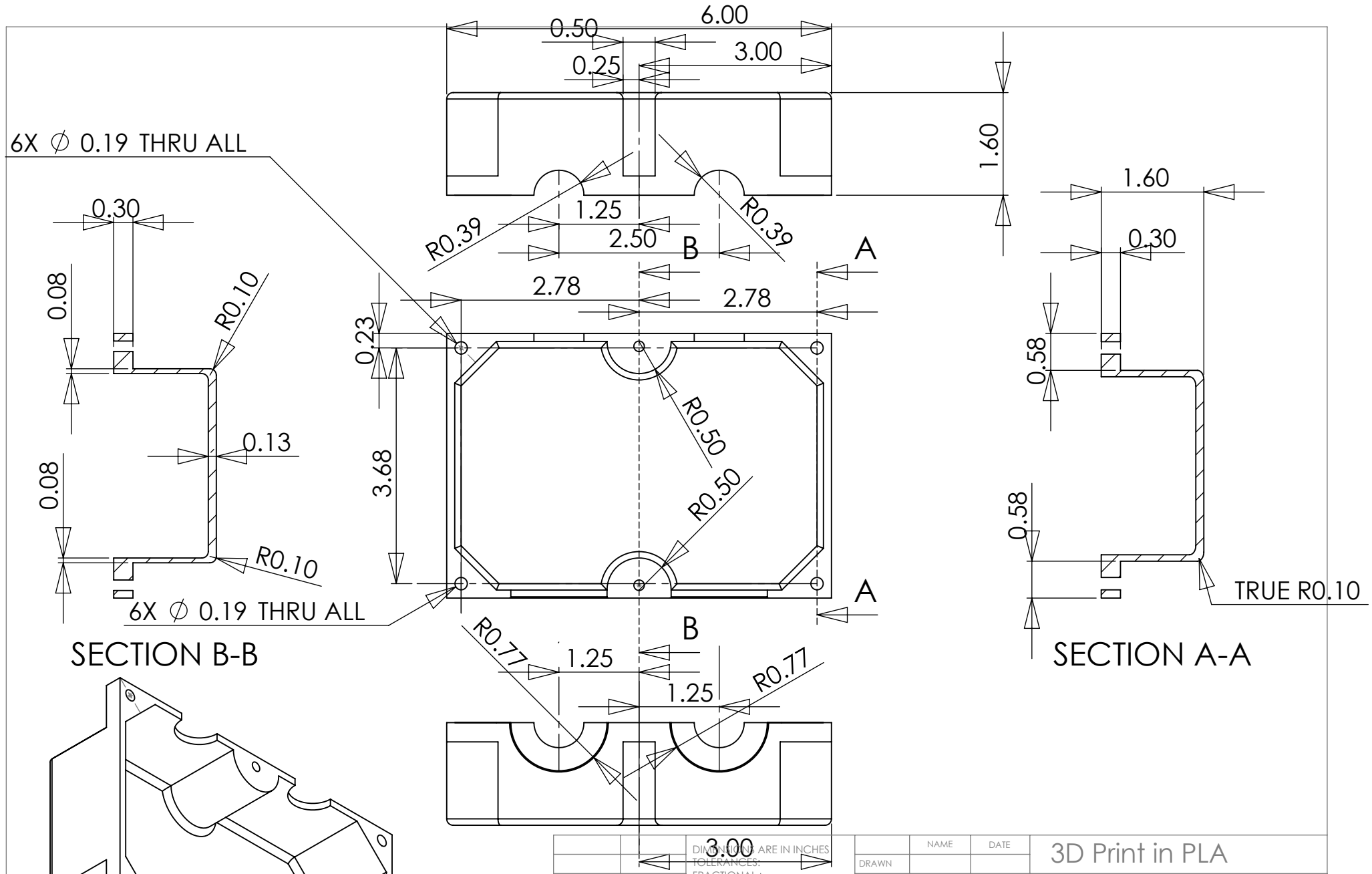

	NAME	DATE
DRAWN		
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

NEXT ASSY | USED ON

APPLICATION

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL --

FINISH --

DO NOT SCALE DRAWING

3D Print in PLA

Cooler outlet box (Bottom)

SIZE	DWG. NO.	REV.
A		

SCALE:1:2 | WEIGHT: | SHEET 1 OF 1

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